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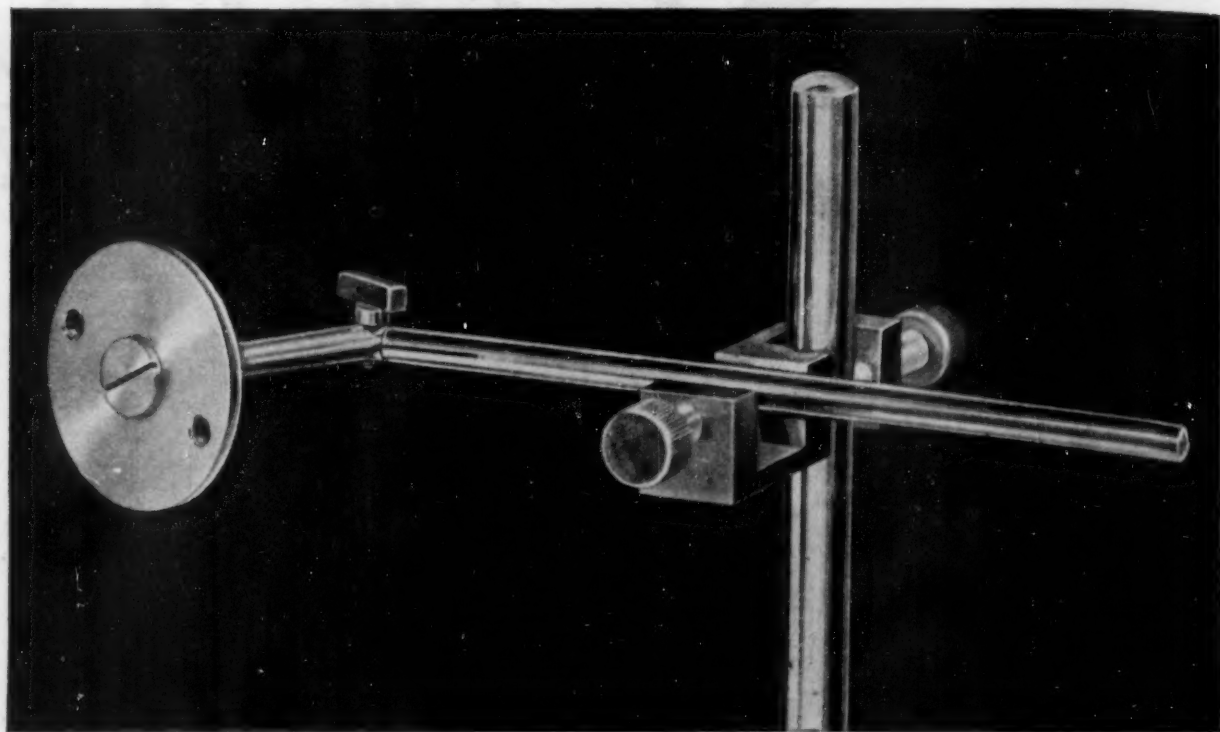
The Executive Committee of the AAAS shown at a meeting in Washington, D. C., on November 1. *Left to right:* seated—Anton J. Carlson, Kirtley F. Mather, F. R. Moulton (administrative secretary of the Association), and Harlow Shapley; standing—Edmund W. Sinnott, George A. Baitzell, Fernandus Payne, Karl Lark-Horovitz (general secretary of the Association), Walter R. Miles, and E. C. Stakman. Members of the Committee not present were Drs. Conant, Compton, and Kettering.

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Biosynthesis of Penicillins

For the Physiological Laboratory

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The HARVARD APPARATUS COMPANY, Incorporated
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The Editorial Board of the Monograph on the Chemistry of Penicillin

THIS BRIEF SUMMARY IS A PRELIMINARY notice of findings secured up to the end of 1945 in a collaborative effort of a large number of American and British investigators working under the auspices of the Office of Scientific Research and Development and the Medical Research Council. Full details will be published in the forthcoming penicillin monograph, together with an account of experiments not referred to in this report.

In the consideration of methods for increasing the fermentative production of penicillin, it appeared that the yields might be limited by the inability of the mold to produce adequate amounts of essential intermediates. Studies of the biochemistry of penicillin formation were undertaken in several laboratories to determine whether products from the chemical degradation of penicillin, possible metabolic intermediates, or other similar substances might be capable of stimulating the production of penicillin. These studies have been successful; by the addition of certain precursors to the fermentative media the yield of penicillin has been substantially increased. The method has also been found to be applicable to the synthesis of new penicillins, several of which have been obtained in yields representing as much as 60-100 per cent of the total penicillin formed. A number have been isolated in pure crystalline form.

Studies carried out in the Northern Regional Research Laboratories (5) indicated stimulation of penicillin production in surface cultures by phenylacetic acid. Attempts to demonstrate an influence on the type of penicillin produced were not successful. The effect on submerged cultures was questionable, and the work was carried no further in the Peoria laboratory.

Independently, investigators in the Glaxo Laboratories (17) undertook experiments with the express intention of studying the biosynthesis of penicillin. The stimulus for this effort was provided by a report from Imperial Chemical Industries (3) that two different strains of *Penicillium notatum* produced principally benzylpenicillin on a corn-steep medium, but principally 2-pentenylpenicillin on a synthetic medium. It was found that a constituent of corn-steep protein, phenylalanine, in 0.25-1 per cent concentration, or a number of deamination or decarboxylation products of phenylalanine in smaller concentrations, stimulated penicillin production

in surface cultures. By means of chromatographic separations, the production of benzylpenicillin in a synthetic medium in the presence of phenylacetamide by *P. notatum* was demonstrated under cultural conditions which, without the adjuvant, had previously given no indication of producing any highly active principle other than 2-pentenylpenicillin (4).

TABLE 1
REPRESENTATIVE COMPOUNDS EFFECTIVE AS BENZYLPENICILLIN
PRECURSORS*

	Stimulation	Concentration (mg. %)	Reported by:
DL-Phenylalanine	1.82	250	Glaxo (17)
Phenylacetic acid	+	10	" (17)
	-	11	Lilly (7)
Phenylacetamide	2.0	100	Glaxo (17)
β -Phenylethylamine	2.0	50	" (17)
N-Phenylacetyl-DL-valine	1.64	20	Lilly (8)
N-(2-Hydroxyethyl)-phenylacetamide	1.57	14	" (10)
N-(2-Aminoethyl)-phenylacetamide	1.56	14	" (9)
2-Aminoethyl phenylacetate (hydrochloride)	1.26	17	" (11)
N-Allylphenylacetamide	1.48	14	" (13)
N-Methylphenylacetamide	1.04-1.73	10	Cutter (6)
	1.53-1.83	25	Heyden (16)
N-Hydroxymethylphenylacetamide	1.55	10	Abbott (1)
N-(2-Hydroxyethyl)- γ -phenylbutyramide	1.35	16	Lilly (12)
δ -Phenylbutylamine (sulfate)	1.39-1.54	13-25	Heyden (16)

* "-" indicates no stimulation in yield; "+" indicates positive stimulation; the numbers under "Stimulation" represent the ratio: units in test container/units in control container.

Among the American workers, the Upjohn Company (18) had reported testing the effects of several compounds, and the Lilly Research Laboratories (7) had initiated extensive studies on precursors. The Lilly studies led to the discovery of several groups of phenylacetyl derivatives that were effective in increasing penicillin yields—in this case, with submerged cultures. Table 1 lists a number of representative compounds found effective in the various laboratories. Considerable specificity was evident in the ability of the molds to utilize compounds. Although N-phenylacetyl-L-valine was an effective precursor, N-phenylacetyl-D-valine did not serve as a stimulant. Mixtures of phenylacetic acid and DL-valine or phenaceturic acid and acetyl-DL-valine were ineffective. The group of phenylacetylated amino acids that proved to be stimulatory was found to be limited.

It is of interest that the response of different strains to specific compounds varies. It has already been pointed

The monograph entitled *The chemistry of penicillin*, now in preparation under the supervision of the National Academy of Sciences and the Office of Scientific Research and Development, is to be published by the Princeton University Press.

out that certain submerged-culture strains did not utilize phenylacetic acid. It is now recognized that the more recently discovered strains, Q-176 and X1612, respond to the addition of this compound.

It is obvious that an increase in the yield of a biological product upon addition of a given substance to a medium may be caused through other mechanisms than that of precursor action. For example, a stimulation of production may be due to utilization of a compound either as a vitamin or growth promoter, as a building block to be incorporated into mycelial growth, or to satisfy any one of several other types of metabolic requirements. To ascertain whether the stimulation in penicillin production was due to a direct utilization of the precursor, the Lilly workers suggested (8) that deuteriophenylacetyl-DL-N¹⁵-valine¹ be added to a culture medium. By means of the deuterium analysis it was shown that 92.5 per cent of the resulting penicillin was derived from the precursor. In sharp contrast, the N¹⁵ content was only 2.6 per cent of the value expected if the phenylacetylvaline had been utilized intact. Although it is apparent that the phenylacetyl moiety appeared in the penicillin, the role of the amide portion of the molecule remains undefined. N¹⁵-Phenylethylamine was also used as a precursor (2). There was a significant quantity of N¹⁵ in the penicillin produced, as judged from the penillic acid isolated from it. The quantity of N¹⁵ introduced was small, representing only 1.65 per cent of the amount that could have been introduced if the nitrogen of the phenylethylamine were the sole source of one of the nitrogen atoms in the resulting penillic acid.

In contrast to the effective incorporation of benzylpenicillin precursors, no unequivocal utilization of precursors for the natural aliphatic penicillins has been demonstrated.

Arnstein, Catch, Cook, and Heilbron (2) used *p*-hydroxyphenylacetic acid in surface cultures. Although there was no increase in absolute yield, they were able to demonstrate that in place of the usual small proportion (about 5 per cent) of *p*-hydroxybenzylpenicillin, approximately 35 per cent of this penicillin was produced in the presence of 0.05 per cent of *p*-hydroxyphenylacetic acid. The Lilly group presented evidence of the production of this penicillin by the use of N-(2-hydroxyethyl)-*p*-hydroxyphenylacetamide in submerged cultures. In lots prepared without precursor, no *p*-hydroxybenzylpenicillin was demonstrable. However, with the use of 0.025 per cent of the compound, an appreciable penicillin fraction was found which had solubility characteristics and a differential assay value comparable to authentic

p-hydroxybenzylpenicillin. These results clearly offer the opportunity of controlling the production of *p*-hydroxybenzylpenicillin.

The Lilly workers discovered also that derivatives of various substituted acetic acids other than those which occur in natural penicillins could act as precursors, and these led to new penicillins containing the acyl portion of the precursor. In view of the marked specificity exhibited

TABLE 2
NEW CRYSTALLINE BIOSYNTHETIC PENICILLINS

Penicillin formed	Precursor used	Activity (U/mg.)	Differential assay*	Reported by
1. Sodium <i>p</i> -methoxybenzylpenicillin	N-(2-Hydroxyethyl)- <i>p</i> -methoxyphenylacetamide	1,510	0.82	Lilly (1)
2. " <i>p</i> -nitrobenzylpenicillin	N- <i>p</i> -Nitrophenylacetyl-DL-valine	1,700 (?)	0.86	" (1)
3. " <i>p</i> -fluorobenzylpenicillin	N-(2-Hydroxyethyl)- <i>p</i> -fluorophenylacetamide	1,650	0.89	" (1)
4. " <i>m</i> -fluorobenzylpenicillin	N-(2-Hydroxyethyl)- <i>m</i> -fluorophenylacetamide	2,340	0.76	" (1)
5. " <i>o</i> -fluorobenzylpenicillin	N-(2-Hydroxyethyl)- <i>o</i> -fluorophenylacetamide	1,340	1.08	" (1)
6. " <i>p</i> -chlorobenzylpenicillin	N- <i>p</i> -Chlorophenylacetyl-DL-valine	2,460	0.73	" (1)
7. " <i>p</i> -bromobenzylpenicillin	N-(γ - <i>p</i> -Bromophenylbutyryl)-DL-valine	2,270	0.65	" (1)
8. " <i>p</i> -iodobenzylpenicillin	N-(2-Hydroxyethyl)- <i>p</i> -iodophenylacetamide	2,800 (?)	0.67	" (1)
9. " 2-thiophenemethylpenicillin	N-(2-Hydroxyethyl)-2-thiopheneacetamide	1,685	1.13	" (1)
10. " phenoxy-methylpenicillin	N-(2-Hydroxyethyl)-phenoxyacetamide	1,670	0.87	" (1)
11. " <i>p</i> -tolylmercaptomethylpenicillin	<i>p</i> -Tolylmercaptacetyl-DL-valine	1,285 (?)	0.83	" (1)

* The differential assay represents the ratio of activity *B. subtilis*/*Staph. aureus*, with that for benzylpenicillin defined as being 1.00.

by most enzyme systems, the ability of the mold to utilize a variety of precursors and incorporate portions of these structures into new penicillins could hardly have been predicted. The utilization of N-(*p*-tolylmercaptacetyl)-DL-valine to form *p*-tolylmercaptomethylpenicillin may be cited as one of numerous examples of the incorporation of a biologically-foreign substance into penicillin.

In some cases addition of precursors to the culture medium caused an increase in production of penicillin activity. Such stimulation may be interpreted as strong evidence for the utilization of the precursor. In other cases no increase of total yield was experienced, and on occasion a diminution of total yield was observed. Such absence of stimulation cannot be interpreted, however, as constituting proof that the mold fails to utilize the precursor. It has been demonstrated in some cases that

¹The deuteriophenylacetic acid was furnished by David Rittenberg, of the College of Physicians and Surgeons, Columbia University. N¹⁵-DL-Valine was prepared and transformed into deuteriophenylacetyl-N¹⁵-valine in the Lilly laboratories (11). The cultural work and preliminary purification were done at the Abbott Laboratories. Final purification and crystallization were effected by The Upjohn Company (19). The isotopic determinations were performed by Dr. Rittenberg.

precursor is utilized and the corresponding penicillin formed. For example, addition of N-(2-hydroxyethyl)-phenoxacetamide to the culture medium did not appreciably increase the total units of penicillin activity produced, but a high percentage of the penicillin was isolated as a single fraction which was shown to be the new phenoxymethylpenicillin.

A large number of compounds were prepared and tested as possible precursors of new penicillins, and in several cases the new penicillins were isolated in analytically pure, crystalline form (Table 2). Each of the new penicillins listed, except numbers 2, 8, and 11, gave satisfactory analytical values and was further identified by the ultraviolet absorption curve in comparison with that of the precursor used. The three exceptions, *p*-nitrobenzylpenicillin, *p*-iodobenzylpenicillin, and *p*-tolylmercaptomethylpenicillin, were obtained in a somewhat impure state, but the presence of these new penicillins was demonstrated by examination of their ultraviolet absorption spectra. It will be noted that *p*-bromobenzylpenicillin was isolated after the use of N-(γ -*p*-bromophenylbutyryl)-DL-valine. Examples of terminally phenyl-substituted butyl and butyryl compounds that have been used as benzylpenicillin precursors are given in Table 1. It is apparent that substituted butyric acid derivatives are effective in a manner similar to the corresponding substituted acetic acid derivatives.

Attempts to find precursors for the three-carbon moiety or the penicillamine portion of the penicillin molecule have been unsuccessful.

The following groups have participated in the joint program for the chemical study of penicillin and have

contributed to various aspects of the precursor work: In Britain, British Drug Houses, Ltd.; Glaxo Laboratories, Ltd.; Imperial Chemical Industries, Ltd.; Imperial College of Science, London, Department of Organic Chemistry; and Oxford University, Department of Crystallography; in the United States, Abbott Laboratories; U. S. Department of Agriculture, Northern Regional Research Laboratory; Cutter Laboratories; Heyden Chemical Corporation; Eli Lilly and Company; Merck and Co., Inc.; and The Upjohn Company.

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The National Academy of Sciences:

Abstracts of Papers Presented at 1947 Autumn Meeting

Growth of Particles in Smokes and Clouds and the Production of Snow From Supercooled Clouds

Irving Langmuir

General Electric Company

V. J. Schaefer introduced pellets of dry ice into clouds of supercooled water droplets and produced enormous numbers of minute ice crystals which rapidly grew into snowflakes. B. Donnegut found that silver iodide vaporized into air can give nuclei which induce the formation of snowflakes in supercooled clouds below -5°C . Account is given of the development of these ideas from studies made during the war of fundamental aspects of: (1) gas mask filters; (2) smokes needed for screening purposes; (3) the radio interference caused by the electric charging of aircraft flying through snow; and (4) the icing of aircraft when flying through supercooled clouds. A theory of the growth of particles in aerosols has served as a guide in these various researches. The experiments in progress during the

last year on the artificial production of rain and snow, now Project Cirrus with the Signal Corps and the Navy, have led to many interesting results which are described and explained. The generation and wartime use of screening smokes and the effects produced by the seeding of stratus and cumulus clouds are illustrated. A preliminary account of the flight tests over the recent hurricane of October 10-15 is given.

Physical Families of Curves

Edward Kasner

Columbia University

In any field of force the most important curves are the trajectories (paths of possible motion). Thus, for the Newtonian field we have the planetary orbits, the conic sections of Kepler. Another important physical family is formed by the generalized catenaries, forms of equilibrium of a suspended chain. Other physical families in the field are brachistochrones and velocity curves.

Analogues and differences between these families are explored. The number of parameters (degrees of freedom) is always the same (three for the plane, five for space). The focal locus is always circular, but the position of the focal circle varies. The locus of the centers of all the circles is found. The fundamental theorem about starting from rest (ratio of curvatures is one-third) is generalized.

Relativistic Wave Equations

Eugene P. Wigner

Princeton University

Recent work by Gelfand and Newmark (*J. Phys. USSR*, 1946, 10, 93; cf. also V. Bargmann, *Ann. Math.*, 1947, 48, 568) and of L. Garding (personal communication) has established that infinitesimal operators in the usual sense can be defined also for representations of open groups. The representations of the inhomogeneous Lorentz group which have been obtained previously (*Ann. Math.*, 1939, 40, 149) by the consideration of finite transformations must also be obtainable, therefore, by considering the infinitesimal operators.

The most important combinations of infinitesimal operators which commute with all infinitesimal operators are $\mu = p_1^2 - p_2^2 - p_3^2 - p_4^2$ and $\nu = w_1^2 + w_2^2 + w_3^2 - w_4^2$, where $w_1 = M_{23}p_4 + M_{34}p_2 + M_{42}p_3$, etc., and the p and M are the infinitesimal operators of displacement and of space-time rotations, respectively. Both μ and ν assume a definite numerical value in an irreducible representation. If $\mu > 0$, one is led, as is well known, to the linear manifolds of the particles with finite mass and spins 0, $\frac{1}{2}$, 1, . . . etc. If, however, $\mu = 0$, the remaining ν alone does not permit characterization of the linear manifolds. In particular, from $\mu = 0$, $\nu = 0$, the vanishing of all 6 expressions $p_j w_k - p_k w_j$ follows, and this makes it possible to define a scalar s by stipulating that $w_j \pm i s p_j$ vanish also. This discussion shows that, in some cases, the consideration of the finite operators affords a more powerful tool for the determination of the irreducible representations than the use of the infinitesimal operators only.

The manifolds with $\mu = 0$, $\nu = 0$ are well known to characterize particles with zero rest mass and spins $s = 0, \frac{1}{2}, 1, \dots$ etc. Manifolds which were not discussed before are obtained by setting μ zero but keeping ν finite. These manifolds can be characterized by the equations

$$(p_1^2 - p_2^2 - p_3^2 - p_4^2)\psi = 0 \quad (1)$$

$$(\xi_1 p_1 + \xi_2 p_2 + \xi_3 p_3 - \xi_4 p_4)\psi = 0 \quad (2)$$

$$(\xi_1^2 + \xi_2^2 + \xi_3^2 - \xi_4^2 - 1)\psi = 0 \quad (3)$$

$$\left(p_1 \frac{2}{\partial \xi_1} + p_2 \frac{2}{\partial \xi_2} + p_3 \frac{2}{\partial \xi_3} + p_4 \frac{2}{\partial \xi_4} - i \Xi \right) \psi = 0. \quad (4)$$

The ψ can be thought of as depending on the 8 variables $x_1, x_2, x_3, x_4, \xi_1, \xi_2, \xi_3, \xi_4$. The p then must be replaced by the corresponding $\partial/\partial x$. The infinitesimal operators of space-time rotations assume the form $M_{12} = x_1 \partial/\partial x_2 - x_2 \partial/\partial x_1 + \xi_1 \partial/\partial \xi_2 - \xi_2 \partial/\partial \xi_1$, etc. The first two terms of the M do not give any contribution to the w . As a result, when calculating ν , one obtains

$$\nu = \sum m_{ik}^2 \mu - \sum (m_{ik} m_{kl} + m_{kl} m_{li}) p_i p_l, \quad (5)$$

where the $m_{12} = \xi_1 \partial/\partial \xi_2 - \xi_2 \partial/\partial \xi_1$, etc. commute with the p . The first sum vanishes because of (1); the second can be evaluated by means of (2), (3), (4) to be equal to Ξ^2 . This shows that the above set of equations actually corresponds to the case $\mu = 0$, $\nu = \Xi^2$.

Solar Activity as the Origin of Cosmic Rays

Donald H. Menzel and Winfield W. Salisbury

Harvard University

(Introduced by Harlow Shapley)

Magnetic fields of sunspots may exhibit random fluctuations of the order of from 1 to 30 gauss. These variations are associated with the gustiness and turbulence of the solar atmosphere. As one consequence of these fluctuations, the sun will emit radio noise the frequencies of which range from perhaps 2 cycles/minute to 1,000 cycles/second. Because of the long wave lengths, the radiation can escape from the sun, especially in regions where magnetic fields reduce the conductivity. The energy also can penetrate the ionosphere of the earth. Observations made with a loop antenna and a frequency amplifier indicate that oscillations of this type occur on the earth's surface.

Magnetic fields limit the energy that a charged particle can assume, the light electrons being more inhibited than the heavier ions. In space, within a few million miles of the earth, heavier ions may attain energies as great as 10^{11} volts. It is suggested that cosmic rays result from such action. Cosmic ray showers are explained as arising from a local cloud of ions and not as secondaries from a single particle. The neutral component comes from the splitting of heavier atoms into neutron-proton constituents as they encounter the earth's atmosphere.

The theory outlined above makes cosmic rays a local phenomenon. The radio waves responsible for the cosmic rays also produce other effects. They cause appreciable heating of the solar atmosphere and lead to the million-degree temperature of the solar corona. The emission exerts a cooling action on sunspots. The light of the night sky and aurora borealis are electrodeless discharges in the electric field of the radiation. Other effects include certain types of ionospheric disturbances and the existence of a potential gradient in the earth's atmosphere.

Initial Performance of a 32-Mev Proton Linear Accelerator

Luis W. Alvarez, Hugh Bradner, Hayden Gordon, Lauriston C. Marshall, Frank Oppenheimer, Wolfgang K. H. Panofsky, Chaim Richman, Robert Serber, Clarence Turner, and John R. Woodyard

Radiation Laboratory, University of California, Berkeley

A beam of 32-Mev protons has been produced by the linear accelerator. Four-Mev protons from a Van de Graaff generator are injected into a resonant cavity operating at about 200 megacycles and driven by 23 oscillators delivering a total of 1.5 megawatts peak power. The beam is phase stable and focused radially by the action of grids of tungsten wire. Absorption measurements show the beam to have an energy of $32 \pm .5$ Mev, in agreement with that predicted from the mechanical design. This work was done under the auspices of the U. S. Atomic Energy Commission.

Creep and Plastic Flow of Solid Materials

Henry Eyring

University of Utah

Stresses applied to solids cause elastic deformations accompanied by plastic flow. The latter may be permanent or may disappear after the stress is removed. Maxwell long ago formalized such an analysis by writing

$$\frac{ds}{dt} = \frac{1}{G} \frac{df}{dt} + \frac{1}{\eta} f, \quad (1)$$

where s , f , t , G , η are the strains, stress, time, Hooke's law constant, and viscosity, respectively. The supposed linear dependence of rate of strain, $\frac{ds}{dt}$, on the stress, f , is not true.

Thus, in certain steels increasing $\frac{ds}{dt}$ by 1,000-fold only requires

10 per cent increase in f , and in certain textile fibers an increase in $\frac{ds}{dt}$ by 25-fold only requires a change in f of 16 per cent.

In 1936 the author showed that if plastic flow is recognized as being a relaxation process, it must obey the statistical laws characterizing chemical reactions, and equation (1) becomes

$$\frac{ds}{dt} = \frac{1}{G} \frac{df}{dt} + r \left\{ \frac{kT}{h} e^{-\frac{\Delta F^*}{kT}} \left(e^{\frac{fV_1}{kT}} - e^{-\frac{fV_2}{kT}} \right) \right\}. \quad (2)$$

where, r is dimensionless, and for tension becomes the ratio of the increase in length for each individual relaxation event divided by the distance between relaxing regions in the direction of extension; the bracketed expression is the usual expression for a rate of reaction; f is the applied force per unit area and, when multiplied by the volume V_1 , gives the work done on the relaxing unit as it passes from the normal to the activated state; fV_2 is the extra work a unit reversing the relaxation must do against the applied force. When fV_1 and fV_2 are small compared with kT , equation (2) reduces to (1). In other cases, the exponential dependence of $\frac{ds}{dt}$ on f quantitatively explains the previously observed nonlinearity. For a symmetrical potential barrier, $V_1 = V_2$. This relaxation theory has been found extremely useful in explaining the observed plastic behavior of textiles, rubber, metals, and inorganic compounds. Some of these results are shown.

Equation (2) provides an explanation for some results reported by Bridgman in which large hydrostatic pressures greatly increase breaking strengths. Thus, the free energy of activation, ΔF^* , for any rate process can be written as

$$\Delta F^* = \Delta F_0^* + p\Delta\bar{V}.$$

where, ΔF_0^* , which is the free energy of activation at zero pressure, is increased by the pressure multiplied into the mean volume of the hole, $\Delta\bar{V}$, required to permit the flow process. Thus, in (2), if $\Delta\bar{V}$ is about the size of V_2 , it is clear that any increase in pressure will cause a corresponding increase in the stress per unit area, f , necessary to maintain a given rate of distortion. Pressure, by selectively slowing down the processes involving the larger holes, $\Delta\bar{V}$, changes the nature of the flow process. The effect of pressure in increasing breaking strength

in particular is due to the slowing down of the individual rate processes involved in breaking.

So far as we are now able to see, all deformation problems are interpretable in terms of the individual relaxation processes which have been briefly sketched.

Viscosity, Sedimentation, and Diffusion of Polymers in Solution

P. Debye and Arthur M. Bueche

Cornell University

Staudinger suggested that the intrinsic viscosity of a polymer solution should be proportional to the molecular weight of the polymer molecule. In the course of time it has been shown that a rule stating proportionality with another power of the molecular weight (usually between 1 and $\frac{1}{2}$) represents the experimental facts much better. A similar behavior is found for the sedimentation and diffusion constants.

It seems important to investigate whether such relations are more than convenient interpolation formulae and, if it should turn out that they are not, to find which relations should be substituted. If such more fundamental relations can be found, it remains to be seen in which sense the customary power relations can be considered as an approximation and what the significance is of the numerical constants, entering in such relations, in terms of the molecular structure of the polymer molecule.

The polymer molecule is represented as a pearl string, with beads representing the monomer and freedom of motion of its links representing the more or less restricted freedom of rotation of the chemical bonds around each other. Such a model leads to Staudinger's original rule, provided it is assumed that the disturbance of the general flow in the liquid due to each bead dies out so rapidly with increasing distance that its effect on the flow around the other beads can be neglected. This, however, does not hold, and the situation is analogous to that of a dielectric in an electrical field, a case in which the electric moments of the different elements of volume of the dielectric create an additional field which has to be taken into account.

The mathematical problem of taking into account the interaction of the beads has been put in a simplified mathematical form. The flow is calculated around and through a spherical particle, the interior of which offers an added resistance to the flow proportional to the number of beads it contains per unit volume. The computed velocity distribution is used in order to calculate the intrinsic viscosity. This quantity now depends on (a) the volume of the sphere, (b) a number, which has been called the "shielding ratio," defined as the quotient of the radius of the sphere and a length, the "shielding length," which is proportional to the reciprocal of the square root of the bead density within the sphere. This length measures how far the effect of the outside velocity distribution reaches into the interior of the sphere.

Discussing the intrinsic viscosity as a function of the degree of polymerization of the polymer chain according to this theory, it is found that for short chains the intrinsic viscosity is proportional to the molecular weight. With increasing chain length this increase is retarded, and in the limit for very long chains the intrinsic viscosity becomes proportional to the square root of the molecular weight. Over a restricted region of molecular weights the curve can be approximated by a

power of the molecular weight between 1 and $\frac{1}{2}$. This exponent of the power rule is a measure for the shielding ratio. After this shielding ratio has been determined, measurements of the intrinsic viscosity can be used to determine the average space occupied by the polymer chain in the solvent. In the case of polystyrene, the size of this space calculated from viscosity compares favorably with the size determined by an interference method based on the observed angular dissymmetry of the light scattered by the solution.

Similar calculations for the sedimentation and diffusion constant have been made by A. M. Bueche. Again, the power rule is interpreted as an approximation and its exponent explained as an effect of the shielding.

Influence of Ultrasonic Irradiation Upon the Phase Transition in the Formation of Colloidal Sulfur

Victor K. La Mer and James W. Yates
Columbia University

When dilute sodium thiosulfate (0.0012M) and HCl (0.0024M) are mixed, the resulting solution remains crystal clear for a reproducible time of 47 ± 1 minutes. The reproducibility of this time appears to be independent of the source of the distilled water. Measurements (La Mer and Kenyon. *J. colloid Sci.*, 1947, 2, 257; Johnson and La Mer. *J. Amer. chem. Soc.*, 1947, 69, 1187) of the ultraviolet absorption (3,100 Å.) in a Beckman Spectrophotometer show that molecularly dispersed sulfur is being continually produced at an accelerating rate until a critical limiting degree of supersaturation ($\sim 3.10^{-6}$ g atoms S/l.) is reached which can no longer be tolerated by the system. This time limit is signaled by the appearance of a Rayleigh type of Tyndall beam. It corresponds to a phase transition wherein the molecularly dispersed sulfur is converted into droplets of supercooled λ sulfur of a size sufficient to exhibit perceptible light scattering, in both the ultraviolet and the visible regions.

Attempts to alter the time of this phase transition by the addition of foreign nuclei, by redistillation of the water *in vacuo*, removal of dissolved gases by boiling, and increasing the content of nitrogen by shaking under 20 pounds of pressure, have proven thus far to be without significant effect.

In view of the well-known property of ultrasonic waves to relieve supersaturation (Sollner. *Chem. Revs.*, 1944, 34, 388), irradiation of the reaction solutions was tried at 400 kilocycles. The results were startling. The normal time of 47 minutes was increased fourfold. More carefully planned experiments show that the effect is not due to the production of H_2O_2 or any detectable chemical change upon the reactants. In fact, the delay can be produced simply by irradiating the distilled water to which the proper amount of concentrated HCl and thiosulfate is added after the treatment. In these cases two to four minutes irradiation of distilled water delays the onset of the phase transition to 3-7 hours.

Preliminary measurements on the ultraviolet absorption show that the production of molecularly dispersed sulfur from the homogeneous reaction continues beyond the normal period of 47 minutes, resulting in a much higher (~ 5 -fold) degree of supersaturation than exists at the normal time limit for the transition to colloidal sulfur.

It would appear that the ultrasonic radiation removes some

unknown nuclei, presumably present in fairly constant number in distilled water, which normally play a role in the condensation process in the colloid formation. The normal phase transition is apparently not one of self-nucleation, as was formerly assumed.

When the initial concentrations of HCl and $Na_2S_2O_3$ are systematically varied, the normal timing of the transition is affected in a reproducible manner, the normal critical limiting supersaturation appears to be constant, but the number of particles formed, as judged by the light absorption as a function of wave length (Barnes and La Mer. *J. colloid Sci.*, 1947, 1, 79; Barnes, Kenyon, Zaiser, and La Mer. *Ibid.*, 1947, 1, 333), varies with the concentration.

When the irradiated water is divided into two aliquots, one of which is carefully protected from air and atmospheric dust and the other is not, the times were found to be roughly 7 and 3 hours, respectively. Experiments are in progress to test various hypotheses of the nature of the nucleation process.

Recent Experiments With the 184-Inch Cyclotron

R. L. Thorton
University of California
(Introduced by E. O. Lawrence)

Study of disintegrations and other nuclear processes involving nuclear projectiles of energies in the neighborhood of several hundred million electron volts will yield important information about the structure of the nucleus, and many laboratories here and abroad are building or planning equipment to reach these energies. The 184-inch cyclotron of the Radiation Laboratory has now been in operation for about one year and provides deuteron and alpha-particle beams of 190 and 380 Mev, respectively. When the deuteron beam strikes any target, splitting of the deuterons yields, in addition to neutrons and protons of energies centering about 90 Mev and emitted in a narrow cone about the deuteron direction. Many experiments have been carried out using these radiations. The results of some of these, and their significance, are discussed.

When these fast particles are incident upon a nucleus, the disintegrations are often more complex than those found at lower energies and frequently result in the ejection of many neutrons, protons, and alpha particles. In addition, fission is produced among many of the heavier elements and has been observed for atomic numbers as low as tantalum. (Such fission produced by very high-speed particles has, of course, no immediate application in the utilization of atomic energy.) Such nuclear events are observed in the cloud chamber and photographic emulsions as well as being deduced from a study of the radioactive isotopes produced.

Other experiments have indicated that nuclei, especially the lighter ones, are partially transparent to very fast particles. Thus, a fast neutron is apparently able to pass through a nucleus with the loss of only a fraction of its incident energy. Experiments indicating this are measurement of total neutron cross-sections and excitation curves for certain nuclear reactions involving light elements.

Evidence of exchange reactions, whereby a fast neutron entering a nucleus will exchange identity with a nuclear pro-

and emerge as a high-speed proton, has been found in a study of neutron-proton scattering. Interactions of this type have long been proposed as contributing to nuclear forces.

Application of X-Ray Diffraction Phase Determinations to the Study of the Structures of Crystals Containing Large Molecules

David Harker

General Electric Company

(Invited paper)

Crystals are three-dimensionally periodic structures with repeating units composed of a small number of atomic groups which may be molecules or ions. The electron distribution of a repeating unit gives rise to variations in the intensities of X-rays diffracted by the crystal in different directions. It is possible to correlate the directions of diffraction with sets of three integral numbers, h , k , ℓ ; and the intensities diffracted in these directions can be interpreted as the squares of the corresponding coefficients of the Fourier Series representing the electron distribution in a repeat unit of the crystal. Thus, the Fourier Series for a crystal is

$$\rho(x, y, z) = \frac{1}{V} \sum_{h=-\infty}^{\infty} \sum_{k=-\infty}^{\infty} \sum_{\ell=-\infty}^{\infty} F_{hkl} e^{2\pi i(hx + ky + \ell z)},$$

where $\rho(x, y, z)$ is the density of electrons at the point (x, y, z) ; V , the volume of one repeat unit; h , k , and ℓ , integers; and F_{hkl} , a number whose square has a magnitude proportional to the observed intensity of X-ray diffraction in the direction characterized by h , k , and ℓ .

The difficulty in finding a structure from an X-ray diffraction pattern is due entirely to the fact that the sign (or phase) of F_{hkl} cannot be found from $|F_{hkl}|^2$, which is what is observed. Various methods of solving this problem have been attempted—none with complete success. Of these, the one due to J. S. Kasper and the speaker seems most likely to lead to the determination of such complex structures as those of proteins.

This method is based on the discovery that the signs (or phases) of some F_{hkl} 's are related to the squared magnitudes, $|F_{h'k'\ell'}|^2$, of other $F_{h'k'\ell'}$'s. These relationships are in the form of inequalities, such as

$$\frac{|F_{hkl}|^2}{(Z_{hkl}^2)^2} = \frac{1}{2} \left(1 + \frac{F_{hkl}}{Z_{hkl}^2} \right),$$

where $(Z_{hkl}^2)^2$ is the maximum possible diffracted intensity in the h , k , ℓ direction for any arrangement of the atoms in the given crystal. The use of this and analogous inequalities can yield the signs (or phases) of enough F_{hkl} 's to allow an approximate determination of the values of $\rho(x, y, z)$, i.e. of the crystal's structure. This crude picture can then be refined by other well-known methods.

Some Recent Studies on Fluorescence

W. Albert Noyes, Jr.

University of Rochester

The study of fluorescence provides one means of obtaining information on the transfer of energy between molecules on collision. The blue fluorescence of acetone has been studied

with sufficient care to show that there are discrete bands. Thus, either it is emitted by excited molecules of acetone or by free radicals in the excited state. There is not enough energy for the latter process. The temperature dependence of the fluorescence indicates that the excited molecules have a stability dependent on vibrational excitation. The transfer of energy between polyatomic molecules during collisions of the second kind has never been fully investigated. The relationship between energy transfers of monatomic, diatomic, and polyatomic molecules is briefly discussed.

Long-Distance Interaction Between Protein Molecules

Alexandre Rothen

Rockefeller Institute for Medical Research

(Invited paper)

When films of antigen (protein or polysaccharide) are transferred onto metal slides, these films are capable of adsorbing specifically layers of homologous antibody as much as 300 Å. thick under certain conditions. Blankets made of barium stearate, octadecylamine, or different plastic materials can be deposited upon the antigenic layers. It is found that, when immune homologous antisera are deposited on top of such blankets, a specific immobilization of homologous antibody takes place in spite of the intervening thickness of the blanket. The possibility of holes in the blankets, thus allowing the antibody molecules to come in direct contact with the antigenic layers by diffusion seems contrary to the experimental evidence. The conclusion is reached that interaction between large molecules involved in immunological reactions may take place through a field of specific long-range forces extending over 200 Å.

Experimental evidence indicates that certain enzymes can exert their action on films of antigen through intervening blankets of plastic material. The thickness of the blankets necessary to protect the antigenic layers depends greatly on the number of these layers and their mode of deposition—a fact which shows that the phenomenon involved is not a simple diffusion of the enzyme molecules.

The Size, Shape, and Charge Distribution of Protein Molecules

J. L. Oncley

Harvard Medical School

(Invited paper)

Protein molecules, unlike other macromolecules, usually contain large numbers of positively and negatively charged groups as well as polar and nonpolar groups arranged in specific positions in rigid structures. Many chemical and biological properties of proteins depend upon the size and shape of these molecules and the positions of the groups in the molecules. These quantities are fundamental in any theory describing the electrostatic interactions and the molecular-kinetic behavior of proteins.

Estimates of size, shape, and charge distribution have now been made for many proteins. These estimates have been obtained from studies of sedimentation and diffusion, osmotic

pressure, viscosity, double refraction of flow, and dielectric constant.

As a first approximation, protein molecules may be represented as ellipsoids of revolution, although these shapes are unquestionably too simple to be completely adequate. Using this assumption, scale models have been constructed of a number of proteins characterized in our laboratory. The β_1 -lipoprotein is the most symmetrical of these molecules, but a number—serum albumin, egg albumin, and β_1 -metal binding protein—have only slight asymmetry. Fibrinogen appears to be far more asymmetrical, a property closely related to its ability to form clots under certain conditions. Completely undegraded gelatin, more like fibrous proteins and synthetic polymers, has about the same length but half the width of fibrinogen.

In certain cases physical-chemical studies have led to more detailed models. Insulin, as it exists in neutral aqueous solution, has been demonstrated to be reversibly dissociated into three smaller units in acid solutions. Hemoglobin under quite different conditions dissociates into two smaller units.

Electromotive force measurements, combined with analytical studies of the amino acid composition, give reliable estimates of the number of positively and negatively charged groups. The distribution of these charges, as evaluated from dielectric constant measurements, is sufficiently asymmetrical to yield dipole moments much greater than those of other known molecules. The most asymmetrical charge distributions were observed for β -lactoglobulin, serum γ -pseudoglobulin, β_1 -metal binding protein, and edestin. Egg albumin and serum albumin appear to have almost symmetrical charge distributions.

Although finer tools will be required to give detailed descriptions of molecules as complex as even the simplest protein, this approach to our understanding of their structure has yielded helpful models of proteins.

Synthesis of Polypeptides

R. B. Woodward

Harvard University

(Invited paper)

Complete hydrolysis of proteins by drastic chemical methods gives mixtures of α -amino acids. By gentler chemical methods, and in particular by enzymatic processes, cleavage products may be obtained which contain two, three, or more amino acids linked by simple amide bonds. These facts have led to the view (Fischer) that the fundamental structural feature of all proteins is that of a long polypeptide chain. The occurrence of variously constituted amino acid units, the opportunity for many different arrangements of units within the chain, and in particular secondary structural features, such as cross-linking between chains by primary bonds, hydrogen bonds, or ionic forces, and manifold opportunities for coiling of long chains, all serve to differentiate the various natural proteins and to confer on each individual certain characteristic properties. In general, these secondary structural characteristics appear to be more important in defining the properties of the globular proteins than of the fibrous proteins. The latter have properties more nearly like those to be expected of rather simple high polymers having the fundamental chain unit ($-\text{CO}-\text{CH}(\text{R})-\text{NH}-$), though even in this class the mole-

cules do not appear to consist of single chains, but rather bundles of two or more chains which may associate and end in the formation of fibrils. Denaturation, the transformation of globular proteins to fibrous modifications, probably involves the unfolding of such a bundle of polypeptide chains which in the globular modification is tightly coiled in a very specific manner.

The properties of the proteins and the structures to which these properties may be attributed are clearly very complicated, but no evidence has been forthcoming which indicates that the complication is one of kind rather than of degree. To the organic chemist the structural forces in the proteins are the same as those operative in the simple molecules with which he is familiar, and the complications arise only from the large numbers of combinations and arrangements of simple atomic interactions. Classically, the task of the organic chemist, once the fundamental structural features of a molecule have been elucidated, is that of synthesis—the duplication to the extent that is possible, of the structure put before him. In the case of the proteins, the first step is clearly that of developing methods for the synthesis of long polypeptide chains. The classical many-step methods of organic synthesis are unsuited to the preparation of materials of high molecular weight, and it is clear that the solution of the problems requires the use of the methods of addition polymerization or an analogous process.

The monomeric species for such a scheme, and indeed the addition polymerization reaction, have long been known, though not recognized as such. Recently, by the polymerization, under carefully chosen conditions, of properly constituted monomers, the synthesis of molecules containing long polypeptide chains with any desired number of different units has been achieved. The preparative results as well as mechanistic considerations and the molecular and physical properties of the products are discussed. The extent to which the phenomena shown by the synthetic materials duplicate those of natural proteins and possibilities for the future, particularly in the testing of hypotheses as to correlations of properties of natural proteins with structural features, are considered.

The Nutritional Significance of Amino Acid Imbalance

C. A. Elvehjem

University of Wisconsin

An interesting relationship between vitamins and amino acids was established when a niacin deficiency was produced in the rat through the use of a diet high in corn and low in proteins. This deficiency was counteracted by the addition of niacin or tryptophane. Evidence is available that tryptophan may function as a precursor of niacin in the animal body.

Further studies with synthetic rations containing 9 per cent of casein have shown that protein hydrolysates, mixtures of amino acids, and specific amino acids produce a significant retardation in growth which may be reversed by the addition of either niacin or tryptophane. Threonine and phenylalanine showed the highest activity of any of the amino acids tested.

The significance of this amino acid imbalance in the prevention of pellagra, in the use of protein hydrolysates and amino acids in therapy and in laboratory studies in which free amino acids are used in place of the intact protein, is discussed.

The Site of Cell Growth

Paul Weiss

University of Chicago

When a nerve fiber is partially constricted, the part lying distal to the constriction (*i.e.* at the far side from the cell nucleus) assumes a reduced diameter, while an excess of cytoplasm piles up at the proximal (*i.e.* near-nuclear) side of the bottleneck. This condition becomes permanent. Various experiments of this type have led to the conclusion that nerve cells are in a state of sustained growth, new protoplasm being continually produced at the site of the cell nucleus and then pressed distad into the fiber. Constriction causes the observed changes in fiber caliber by throttling the centrifugal convection of cytoplasm. When the constriction is later removed, the jammed up cytoplasm can be seen to advance distad. The rate of this advance is of the order of 1 mm./day.

In explanation of this phenomenon, the hypothesis is proposed that the basic protoplasmic systems of the cell, particularly native proteins, cannot be synthesized in the cytoplasm but must be supplied from a nuclear source. On this premise, the rate of presumable natural protein decay in nerve was calculated from known values of ammonia production, and from this the rate of replacement requisite for maintenance of steady state could be derived. This postulated replacement rate was found to be of the same order as the observed rate of proximal distal convection of protoplasm, thus lending support to the proposed concept.

The results indicate a very close relation between the genetic apparatus of the cell, protein reproduction, and the sources of protoplasmic growth.

The present theory rationalizes the experimental literature on olfaction. Among other points, it distinguishes odorous from inodorous substances; explains adaptation as the return of the receptor system to a new thermal equilibrium in the presence of an odorous substance; accounts for the differences between micro- and macro-osmotic animals on the basis of the larger absorption chambers of the latter; accounts for the anomalies in the chemical theory; and provides a basis for the reinterpretation of some of the classic work in olfaction.

Electrical Responses of the Human Retina to Stimulation by Lights of Various Wave Lengths

Lorin A. Riggs

Brown University

(Introduced by Walter S. Hunter)

A contact lens is used to maintain a constant electrical contact between the cornea of the eye and a nonpolarizable electrode. Continuous records are made of the difference of potential existing between this electrode and a reference electrode located elsewhere on the head. When light enters the eye, an electrical response occurs which is manifested as a momentary increase in the positivity of the corneal electrode. That the effects so observed originate in the retina or sensitive layer of the eye has been shown conclusively in various control experiments. The exact nature of the retinal events underlying the electrical response is not well understood at present. The evidence from our recent experiments does show, however, that the scotopic or night visual system is chiefly responsible for the magnitudes and wave forms of the recorded responses. Responses obtained during the process of dark adaptation reveal, for example, that the sensitivity of the eye continues to rise over a period of more than an hour, even when tested with red light. The rate at which visual sensitivity appears to rise in these experiments is consistent with the scotopic portion of the curve of dark adaptation as conventionally obtained by determination of visual thresholds. In other experiments, the eye has been adapted to a constant level of illumination, whereupon electrical responses are elicited by means of test flashes of added illumination. The result again is consistent, for 5 different levels of light adaptation, with the predicted effects of such adaptation upon the scotopic system of the retina. In other experiments, various wave lengths of stimulating flash have been used to reveal the visibility function, based upon magnitudes of electrical response. This function resembles fairly closely the scotopic visibility curves which have been determined by many investigators using a conventional matching procedure. It is concluded that the contact-lens method of recording visual sensitivity has the following characteristics: (1) It provides objective and measurable responses which are not influenced by error of subjective estimation. (2) It reflects only the activity of the retina, uncomplicated by effects occurring in the higher visual centers. (3) It reveals the activity of the scotopic visual system under conditions of light adaptation such that scotopic functions cannot be observed by the usual psychophysical methods because of the intrusion of the photopic system. (4) In spite of the value of the electrical response as an indicator of scotopic sensitivity, its exact nature and point of origin are not well understood.

Some Theoretical and Experimental Relationships Between Infrared Absorption and Olfaction

Lloyd H. Beck and Walter R. Miles

Yale University

According to the proposed theory, olfaction results when the radiation of heat from an organism's receptors is accelerated. The source of heat is the organism itself. The organismic source defines the critical region of the infrared spectrum as that in the neighborhood of the maximum of a black body at approximately 290°–313°K. The receptors, being of the dimensions of the wave lengths in the region of this maximum (8–14 μ), can, by virtue of their size and shape, radiate selectively. Any substance having an absorption band in this region and coming within the radiation field of these receptors will cause them transiently to lose energy. This transient loss of energy is presumably the initial event in the process of stimulation of the olfactory receptors. Differential radiation losses of the receptors account for olfactory quality as spatial stimulation.

In a group of roaches (*Periplaneta americana*) placed between glass chambers equipped with potassium bromide (KBr) windows, one of which was backed with glass, 15 per cent showed antennal activity when air was pulsed through the chambers, 24 per cent showed activity when oil of clove vapor was pulsed through the chambers, and 26 per cent showed activity when oil of clove was released diffusely in the room. These results could have occurred by chance 3 times in 100.

Infrared Absorption in Field Studies of Olfaction in Bees

Walter R. Miles and Lloyd H. Beck
Yale University

The problem in these studies was to determine if infrared absorption bands influence the olfactory behavior of bees. Duplicate units made of cast iron provided the chambers for liquid honey, gas from the honey, and a moisture absorber. An open cooling chamber adjoined the solid end of each gas chamber, a window being sealed into the other end. For chamber "S" the window was a special infrared filter. For chamber "XS" the same filter was used with glass behind it. On small platforms in front of each window a measured number of drops of honey were placed and exposed to the open air in order to attract the bees to work near and in front of the two windows. After the platforms were removed, the subsequent behavior of the bees was studied. They now clustered on the infrared passing window in the ratio of from 3-10 to 1 on the "XS" window. Variations of this experiment have demonstrated, in terms of proportional statistics, reliable indications that the bees prefer the window which passes infrared from the honeyed perfume inclosed in the chamber behind it. These results appear to support the hypothesis that infrared absorption bears a relation to the adequate stimulus for olfaction.

The Predictiveness of Infant Behavior Traits

Arnold Gesell
Yale University

The Yale Clinic of Child Development has made numerous diagnostic and follow-up studies of the growing behavior patterns of normal, atypical, and abnormal infants. The infants were examined at periodic intervals with stenographic recording. A clinical crib, a test table, and test objects were designed to elicit characteristic responses in the four major fields of behavior: motor, adaptive, language, and personal-social. Cinema records of the behavior patterns have been subjected to frame-by-frame inspection and to quantitative analysis. Selected children were observed for a period of 10 years; one pair of identical twins has been intensively followed from infancy for a period of 20 years.

These studies indicate a high degree of predictability in the sequences of mental growth. The sequences follow a general ground plan with variations which are distinctive for each individual. Normal infants in the first three months of life tend to lie with head and arm directed to one side, the opposite arm being crooked at the shoulder. This "tonic-neck-reflex" pattern may be right or left or mixed. Deep-seated preference for the left is predictive of ultimate lefthandedness.

With the aid of finely graded norms of behavior growth, a clinically trained diagnostician can appraise the developmental potentials of the infant. By systematic methods of developmental diagnosis it is possible to diagnose in the first year of life nearly all cases of amentia, cerebral injury, sensory and motor defects, and serious personality deviations. One or two examinations in infancy usually suffice to determine whether a child is suitable for adoption and whether the developmental outlook is favorable, highly favorable, or unfavorable. Examinations in infancy and observation during the preschool years may reveal various forms of giftedness, temperamental quali-

ties, individual modes of growth and learning, and liabilities and assets in emotional make-up.

All these possibilities in the realm of prediction have been demonstrated by clinical applications which operate with significant success when based on a precise knowledge of the developmental mechanisms involved. This knowledge is now only in its crude beginnings. The task of science is to refine the knowledge. Refinement of knowledge will lead to refinement of prediction. A greater concentration of scientific resources on the period of early infancy becomes of supreme importance for preventive medicine and other forms of social control.

Tepexpan Man: A Study of an Ancient Human Skeleton From the Valley of Mexico

Javier Romero
Museo Nacional de Mexico
T. D. Stewart
U. S. National Museum
(Introduced by Alexander Wetmore)

Restoration and study of the human skeleton of late Pleistocene age from near the present town of Tepexpan, Mexico, has now been completed by Sr. Romero under the guidance of Dr. Stewart. Restoration has involved reassembling the broken parts of the face and of the major long bones. The skull is reasonably complete, but the long bones, except for the right radius and ulna, are deficient. Only a few other parts are present or complete enough for study.

In shape, the skull is on the border of brachycrany (C.I. 80) and relatively high. Cranial capacity is high (1,540 cc.), and the endocast shows a well-developed brain. The skull type is close to that of the late Indians of our Southeast. Suture closure indicates advanced age (55-65 years). Sex characters are masculine.

Computation of stature from long-bone measurements yields a figure of approximately 170 cm., which is well above the present average of Mexican Indians. Arthritic changes, notably in the cervical vertebrae, are consistent with the attributed age.

A sculptural representation of the soft parts of the head built upon a cast of the skull and taking into account average tissue thicknesses for whites, shows a typical Indian countenance. This head epitomizes the conclusions of the study, namely, that Tepexpan Man was a typical Indian, although bigger than those living today in Mexico.

The Viking Fund of New York made it possible for Sr. Romero to bring the specimen to Washington, where the Smithsonian Institution supplied laboratory facilities and study collections.

Bikini Revisited—Preliminary Results of the Scientific Resurvey During the Summer of 1947

Commander Roger Revelle, USNR
Geophysics Branch, Office of Naval Research

During July and August of 1947 the Navy Department, in cooperation with other government agencies, carried out a scientific resurvey of Bikini Atoll in order to study the effects of radioactivity on marine organisms living in a natural environment and to extend certain aspects of the geological

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ological, oceanographic, and military investigations conducted in this little known area during 1946. Approximately 100 civilian scientists and technicians participated in the resurvey, representing the U. S. Geological Survey, the Fish and Wildlife Service, the National Museum, the Navy Department, the Atomic Energy Commission, and various universities and research institutions. Four ships were assigned to the expedition, including the *U.S.S. Chilton*, a transport of about 15,000 tons.

Although fishes and other marine animals from the entire lagoon area were often found to contain slight amounts of radioactivity, no large-scale changes were observed in population density of reef or pelagic animals or in the relative abundance of different species. Some coral patches in the target area showed evidence of destructive effects due to the atomic bomb explosions. Reproductive processes in living organisms appeared normal, and no morphological changes were found. Studies of permeability, salt accumulation, bioelectric potential, pigment content, photosynthesis, respiration, enzyme activity, and calcification were carried out on marine algae. By one difference, a higher activity of the hydrogen peroxide decomposing enzyme, catalase, was noted between areas which had received heavy doses of radiation from radioactive substances and those which had not been affected by radiation. Marine bacteria and land organisms appeared unaffected by radiation. In the eastern end of Bikini lagoon the water is considerably more turbid than in the spring of 1946; the cause of this change is not well understood.

The subsurface structure of Bikini Island on the eastern end of the atoll was explored by core-drilling down to a depth of 2,556 feet, nearly two and a half times as deep as the Funa Futi boring, the only previous drilling on a coral atoll. Unconsolidated or very poorly consolidated calcareous sediments—beach rock, reef limestone, coral rubble, and calcareous sand—were found at all depths. Preliminary examination by geologists and paleontologists of the U. S. Geological Survey shows that late Tertiary corals and mollusks were encountered at 930 feet, and it is possible that the top of the Tertiary section may be considerably higher. Seismic velocity determinations in the deep hole suggest a continuous transition to more compacted calcareous materials near the bottom. On the basis of previous geophysical evidence, these may extend down to depths of one to more than two miles.

Studies of the deposition of calcium carbonate indicate a rate of upward growth of the reef of about 1 mm. per year.

Twenty-four dredge hauls were made on the outer slopes of the reef. These show that the outer slope consists near the surface of large blocks of limestone mixed with calcareous sand. The size of the blocks decreases with depth from several tons near the surface to several hundred pounds at depths of more than 200 fathoms. Below 200 fathoms these limestone blocks are rare. From 10 to 100 fathoms, living corals, algae, bryozoa, sponges, and other forms are present in abundance. The profusion and variety of life decreases rapidly with depth; below 100 fathoms the predominant forms are foraminifera, algae, a few deep-water corals, sponges, and brachiopods.

NEWS and Notes

The winners of the two \$1,000 AAAS-George Westinghouse Science Writing Awards for 1947 were selected in New York City on November 20. George A. Keaney, feature writer on the *New York World-Telegram* won the 1947 Newspaper Writing Award for his series of five stories on blood, and more especially on the Rh factor in blood, which appeared in the *New York World-Telegram*, March 18-22, 1947. This year's Magazine Writing Award was won by Steven M. Spencer, associate editor of the *Saturday Evening Post*, for his story, "New Hope for the Anemic" (an article on folic acid), which appeared in the December 14, 1946, issue. The judges further recommended that honorable mention for the Magazine Writing Award be given Lorus J. and Margery J. Milne, free-lance writers,

for their article, "The Life of the Water Film," published in the June 1947 issue of *Natural History*.

A newspaperman for only three years, Mr. Keaney had taught English and civics in the Lawrence, Massachusetts, high school for 13 years. He was born in Lawrence in 1906 and later received his A.B. and M.A. degrees in English from Boston College.

Steven Spencer was awarded a Nieman Fellowship in Journalism at Harvard University in 1939 while he was employed on the *Philadelphia Bulletin* as staff science writer. He later contributed articles to the *Saturday Evening Post* and joined its staff in 1946. Mr. Spencer was born in Omaha, Nebraska, and received an A.B. degree in English at the University of Pennsylvania. He is now living in Swarthmore, Pennsylvania.

The Milnes have contributed to several general circulation magazines during the last year as free-lance writers. They are now living in Burlington, Vermont, where Dr. Milne is associate

professor of zoology in the University's Department of Zoology. Mrs. Milne was formerly associate professor of biology at Beaver College, Jenkintown, Pennsylvania.

The \$1,000 Newspaper Writing Award was made for the first time at the Boston meetings of the AAAS in Chicago, and the Magazine Writing Award was incorporated into the annual program for the 1947 contests. Both of the 1947 awards will be made at a presentation dinner on December 27 during the AAAS meetings in Chicago. Upon this occasion Dr. Shapley will act as toastmaster, and the guest speaker will be George Stoddard, president of the University of Illinois. Through funds provided by the Westinghouse Educational Foundation of the Westinghouse Electric Corporation and under the administration of the AAAS, the annual science writing awards are made in an effort to stimulate and maintain a high standard of science reporting for the lay public through the newspapers and the general circulation magazines.

The judges selecting the 1947 winners were: Benjamin McKelway, editor of the *Washington Star*, and H. L. Mencken, of the *Baltimore Sun* papers, representing newspapers; Clifton Fadiman, of '47, and Edward Weeks, of the *Atlantic*, representing magazines; Kenneth Olson, of the Medill School of Journalism of Northwestern University, and Rudolf Flesch, author of *The art of plain talk*, general representatives; and Detlev Bronk, chairman of the National Research Council, and Edward Weidlein, of the Mellon Institute for Industrial Research, representing science. Dr. Morris Meister acted as chairman of the judging panel.

Visible Directory, Chicago Meeting

Advance registrants, please note: As soon as your hotel reservation in Chicago has been made, either notify the Washington Office of the name of your hotel or, upon your arrival in Chicago, give this information to the attendant at the Information Booth in the Stevens Hotel for posting in the Visible Directory.

About People

James B. Sumner, professor of biochemistry, Cornell University, and the first to crystallize an enzyme, has been appointed director of the Laboratory of Enzyme Chemistry, recently established by the trustees of Cornell University. Dr. Sumner was co-winner of the 1946 Nobel Prize in Chemistry. The new laboratory will be located in Savage Hall, the new building of the School of Nutrition (*Science*, October 10, November 14).

Samuel C. Schmittle has been appointed assistant in the Department of Veterinary Pathology and Hygiene, University of Illinois College of Veterinary Medicine. Dr. Schmittle was graduated from the Ohio State Veterinary College in 1947.

John C. Keresztesy, chemist, Cancer Research Laboratory, Mt. Sinai Hospital, New York City, has been commissioned in the U. S. Public Health Service and has been assigned to the Physiology Division, National Institute of Health, Bethesda, Maryland.

Florence B. Seibert, associate professor of biochemistry, Henry Phipps Institute, University of Pennsylvania, received the honorary D. Sc. degree from Lafayette College, Easton, Pennsylvania, at the Founders' Day exercises, October 18.

Thomas G. Digges, a member of the Metallurgy Division, National Bureau of Standards, since 1920, has been appointed chief, Thermal Metallurgy Section, succeeding **D. J. McAdam**, chief of the Section since 1930, who retired August 31.

Grants and Awards

A publication of the **American Chemical Society**, *Industrial and Engineering Chemistry*, has been awarded first prize for 1947 for "the best issue devoted to a single theme" in the annual competition sponsored by *Industrial Marketing*, Chicago, among the nation's business journals. The award, a silver plaque, was conferred in recognition of the quality and scope of articles on the utilization or disposal of industrial wastes which made up the May issue of the journal, which is edited by Walter J. Murphy, Washington, D. C.

The Seventh Annual Science Talent Search, sponsored by Westinghouse Electric Corporation and Science Service, is now under way. Examinations will be given to the contestants from December 1 to 26, the closing date. From the 300 top-ranking contestants, 40 will be chosen for all-expense trips to the five-day Science Talent Institute in Washington, D. C., February 27 through March 2, 1948, during which the winners will be selected. One girl and one boy will receive \$2,400 Westinghouse Grand Science Scholarships (\$600 a year for four years) and 8 others will receive scholarships of \$400 (\$100 a year for four years). An additional \$3,000 worth of scholarships may be awarded to others of the 40 at the discretion of the judges. Concurrently with the national talent search, 9 states (Alabama, Georgia, Illinois, Iowa, Louisiana, Montana, Pennsylvania, Tennessee, and Virginia) will conduct state searches through a special arrangement with Science Clubs of America. The judges are Harlow Shapley, director, Harvard College Observatory, and president of the AAAS; Harold A. Edgerton and Stuart Henderson Britt, psychologists of New York City; and Rex E.

Burton, psychiatrist of Washington, D. C. By discovering and developing scientific ability at the high school level, two sponsoring institutions, Westinghouse and Science Service, are playing a major role in relieving the critical shortage in scientific talent which is the growing concern of most countries of the world today. More complete information on the program may be obtained from Science Clubs of America, 1719 N Street, N. W., Washington 6, D. C.

The Research Corporation, New York, has recently made several awards of interest. Two physics teachers, **A. Knowlton**, Reed College, Portland, Oregon, and **Clifford N. Wall**, formerly at North Central College, Naperville, Illinois, and now at the University of Minnesota, received special awards of \$1,000 each for distinguished teaching. A survey had shown that of all physics degrees granted Ph. D. degrees in this country between 1936 and 1945, an outstanding number had been undergraduates at Reed and North Central. Two other awards, each consisting of a plaque and \$2,500 honorarium, went to **Lee A. DuBridge**, president, California Institute of Technology, "for his outstanding scientific achievements in directing the Radiation Laboratory of OSRD in the field of microwave radar research, development, and application to national defense," and to **Merle A. Tuve**, of the Carnegie Institution of Washington, in recognition of his scientific contributions in making possible the proximity fuse and his administration of the various groups which equipped the Armed Forces with the device.

William F. Meggers, chief, Spectroscopy Section, National Bureau of Standards, Washington, D. C., was the recipient of the Frederick Ives Medal presented by the Optical Society of America at its 32nd annual meeting at the Netherland Plaza Hotel, Cincinnati, Ohio, October 24.

The University of Pennsylvania has received a grant of \$155,000 from the Carnegie Corporation which is to be extended over a five-year period for the support of a program of Indian and related Asian studies. The program, including both teaching and research and combining the activities of several fields and departments, will include studies of the cultural, political, social, economic, historical, anthropological, and other aspects

of the national life in relation to one another and to the total character of present-day civilization in the Union of India and Pakistan. A special department to be created for administration of the program will be directed by **W. Norman Brown**, professor of Sanskrit and chairman, Department of Oriental Studies, who is now en route to India and Pakistan. The program, designed to train students in many different disciplines to apply their particular techniques to research and study of the Indian aspects of those fields, and to train them for government, business, teaching, and other types of service in India, will be in full operation by the fall of 1948.

Colleges and Universities

The University of Illinois, Division of Biological Sciences, will sponsor three lectures at Urbana by **R. Ruggles Gates**, emeritus professor of botany, University of London. The first lecture, December 1, will be on the topic, "The Evolution of Man." On December 2, Dr. Gates will deliver addresses on "Some Principles of Human Genetics" and "The Nature of Species."

The University of Chicago Cancer Research Foundation has launched a campaign to raise the funds needed to provide Chicago with a very modern and complete cancer center. The sum of \$2,580,000 has already been provided for this program, including \$1,600,000 for the Nathan Goldblatt Memorial Hospital and \$980,000 toward the construction of a new 170-inch cyclotron. Immediate objective of the campaign is to raise the additional \$570,000 necessary to complete the financing of the cyclotron, which has promise, theoretically, for deep radiation, and will be used extensively for research toward this end. It has been so designed that patients may be brought to it for treatment. Final objective is \$2,000,000 for an isotope laboratory, which will be the first building designed for research with radioactive isotopes. Plans for the campaign were outlined at a civic dinner, November 10, in the ballroom of the Stevens Hotel, Chicago, at which, **Charles B. Huggins**, of the University of Chicago, who developed one of the first chemical tests for cancer, gave an address on "New Horizons in Cancer Research," and **Enrico Fermi**, Nobel Prize winner and dis-

tinguished service professor of physics at the University, spoke on "Atomic Energy—Servant of Mankind." The 1,000 guests present also heard special messages from President Truman, who was represented by his personal physician, Brig. Gen. Wallace H. Graham; **Martin H. Kennelly**, mayor of Chicago; and **Maurice Goldblatt**, president of the Cancer Research Foundation.

Iowa State College will have in operation by next spring a new food-processing laboratory, with equipment on a semi-commercial scale for research in canning, freezing, and dehydrating. The building is a two-story barracks-type which will be moved from the Ottumwa naval air base to the Iowa State campus. The processing laboratory and an evaluation laboratory for testing results will be on the ground floor. The second floor will contain an analytical laboratory, classrooms, and space for graduate students to work. Research work will be carried on by the horticulture subsection of the Iowa Agricultural Experiment Station. **E. S. Haber**, head, Department of Horticulture, and **Robert G. Tischer**, research associate professor in charge of food-processing research, will be in charge of the laboratory. The work in the new laboratory will involve cooperation with the Departments of Poultry Husbandry, Home Economics, Bacteriology, Animal Husbandry, and others.

The University of Illinois Graduate School has been renamed the Graduate College upon the recommendation of **George D. Stoddard**, president of the University, in recognition of the increasing importance of advanced studies. The enrollment at the Graduate College is now 2,359, an increase of 34 per cent over last year's enrollment, which in turn had been greater than all previous enrollments. **Louis N. Ridenour**, editor-in-chief of the 28-volume McGraw-Hill series of books on the wartime developments of the Radiation Laboratory at Massachusetts Institute of Technology, is dean of the Graduate College.

Cornell University has established an endowed professorship of metallurgical engineering, named after **Francis Norwood Bard**, owner of the Barco Manufacturing Company, Chicago, who presented a fund of \$250,000 to endow the professorship at a dinner given in his honor. The first occupant of the new

chair is **Peter E. Kyle**, of the Cornell faculty, who will also head a broadened program in metallurgical engineering, already organized in the School of Chemical and Metallurgical Engineering, which is under the over-all direction of **F. H. Rhodes**, director of the School of Chemical Engineering since its founding in 1938. The school will continue to train chemical engineers while preparing other students for responsible positions in research, development, and administration in the metallurgical industries. The new curriculum, a five-year course leading to the degree of bachelor of engineering, already has an enrollment of 27 students. The new program stems from the pioneer interest in metallurgy of the late **Robert Henry Thurston**, an early leader in engineering education, who placed metallurgical engineering among the most important fields of instruction and research at Cornell University.

The Institutum Divi Thomae, Cincinnati, has appointed a Clinical Advisory Committee composed of 9 physicians and scientists to act as a consulting staff in those aspects of its research which pertain to clinical medicine. In addition to **Andrew C. Ivy**, vice-president in charge of the Chicago Professional Colleges, University of Illinois, who is chairman of the Committee, the membership includes, **E. V. Cowdry**, Washington University, St. Louis, vice-chairman; **Josiah J. Moore**, treasurer, American Medical Association; **James H. Hutton**, internist and endocrinologist, Chicago; **Edward C. Compere**, associate professor of orthopedics, University of Illinois College of Medicine; **Karl F. Meyer**, director, George Williams Hooper Foundation for Medical Research, University of California; **Hobart A. Reimann**, professor of medicine, Jefferson Medical College, Philadelphia; **William D. Stroud**, professor of cardiology, Medico-Chirurgical College, Graduate School of Medicine, University of Pennsylvania; and **Albert E. Casey**, assistant professor of pathology, Medical College of Alabama, Birmingham. **Lawrence C. Salter**, Chicago, is secretary of the Committee.

The University of Washington, Seattle, has established a Department of Meteorology and Climatology, which will offer courses in physical and synoptic meteorology, meteorological laboratory, and physical and regional climatology.

Phil E. Church is acting executive officer, and William L. Schallert, formerly a major in the Air Forces Weather Service, is a member of the staff.

Alabama Polytechnic Institute has added four new members to its Department of Botany and Plant Pathology: Kenneth H. Garren, Georgia Agricultural Experiment Station; Donald E. Davis, Ohio State University; Henry S. Ward, Jr., Iowa State College; and James A. Lyle, University of Hawaii Experiment Station.

Industrial Laboratories

The Kellogg Corporation, atomic energy subsidiary of the M. W. Kellogg Company, has appointed as its new director of research and development H. Hugh Willis, formerly chief research director and vice-president, Sperry Gyroscope Company, Inc., and vice-president, Engineering and Product Development, Eversharp, Inc. Mr. Willis will be in charge of all Kellogg research and development on nuclear energy and assist in certain phases of guided missiles development.

Food Research Laboratories, Inc., Long Island City, has named Milton Blitz assistant to the chief chemist, and has appointed Edward Elgen, formerly of the Quartermaster Food and Container Institute, Chicago, to the technical staff.

Meetings

At the 32nd annual meeting of the Institute of Medicine of Chicago, to be held in the Red Lacquer Room, Palmer House, on the evening of December 2, Joseph L. Baer, Rush clinical professor emeritus of obstetrics and gynecology, University of Illinois College of Medicine, will deliver the presidential address on "American Obstetrics and Gynecology: A Mature Specialty."

The American Society of Tropical Medicine, the American Academy of Tropical Medicine, and the National Malaria Society are meeting conjointly for the first time December 2-4, in Atlanta, Georgia. The meeting will feature a symposium on "The Virus Diseases in the Tropics" on the afternoon of December 3. All those interested in tropical

medicine and malaria are invited to attend the meetings.

A Conference on Methods in Philosophy and the Sciences will be held December 7 at the New School for Social Research, 66 West 12th Street, New York City. The morning program will include: "History and the Philosophy of History," Maurice Mandelbaum, Dartmouth College; and "The Great Historian and the Meaning of Truth," Kurt Riezler, New School for Social Research. The afternoon session on "American Public Policy on Science" will be a Symposium on the Report of the President's Scientific Research Board, and will include the following: "Selig Hecht, 1892-1947," Leslie C. Dunn, Columbia University; "The National Planning of Science," Robert F. Steadman, Wayne University, and staff member, President's Scientific Research Board; "Scientific Freedom and National Planning," P. W. Bridgman, Harvard University; and "Science and Secrecy," James R. Newman, Yale University Law School. A discussion from the floor will follow both sessions. All those interested are invited to attend. Registration fee is \$1.00.

The American Mathematical Society will hold its 54th annual meeting at the University of Georgia, Athens, December 29-31, in conjunction with the annual meeting of the Mathematical Association of America. The sessions of the Society will begin at 2:00 P. M. Monday and continue through Wednesday. The Association will meet Thursday morning and afternoon. P. M. Morse, Massachusetts Institute of Technology, will deliver the 21st Josiah Willard Gibbs Lecture on "Operational Research," on Monday at 8:00 P. M. On Tuesday at 2:00 P. M., E. F. Beckenbach, University of California at Los Angeles, will speak on "Convex Functions." There will also be an address on applied mathematics, the title and name of the speaker to be announced later. The Board of Trustees will meet on Monday, and the Council on Tuesday evening. The Annual Business Meeting and Election of Officers will be held Wednesday at 9:30 A. M.

The American Physical Society will hold its annual meeting at Columbia University, January 29-31. Programs are now being arranged by the Division of

Electron Physics, the Division of Solid State Physics, and the Committee representing the nascent Division of Fluid Dynamics. Those desiring to present papers at the meeting should submit titles and abstracts (not over 200 words) in duplicate to Karl K. Darrow, secretary, American Physical Society, Columbia University, New York 27, New York, before December 9. A maximum of 15 minutes will be allowed at the meeting for the oral presentation of a contributed paper.

The 10th annual Midwest Power Conference, sponsored by Illinois Institute of Technology, will be held April 7-9, 1948, at the Sheraton Hotel, Chicago, with Stanton E. Winston, of the Institute staff, as director. Cooperating institutions are: Iowa State and Michigan State Colleges; Northwestern and Purdue Universities; the Universities of Iowa, Illinois, Michigan, Minnesota, and Wisconsin; the Illinois section of the American Society of Civil Engineers; Illinois chapter of American Society of Heating and Ventilating Engineers; Western Society of Engineers; Engineers' Society of Milwaukee; and the Chicago sections of the American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, and American Society of Mechanical Engineers.

The American Dairy Science Association will hold its 43rd annual convention at the University of Georgia, Athens, June 14-16, 1948, making the first time the Association has met at a school farther south than the University of Kentucky. About 600 leading dairy scientists are expected to attend the meeting. The Association's president is Paul H. Tracy, professor of dairy manufactures, University of Illinois.

The Chinese Association for the Advancement of Science (formerly the Science Society of China) held its 25th annual meeting August 30-September 1 at the Academia Sinica and National Medical College of Shanghai, with the Natural Science, Astronomical, Meteorological, Geographical, Zoological, and Anatomical Societies of China participating. H. C. Zen presided over the meeting. The program included addresses by W. H. Wong, who spoke against the secrecy of scientific research and its results, and by K. C. Chu, who emphasized the utilization of scientific knowledge for

peace; the presentation of papers in the various sections; and discussions among the members on "Atomic Energy and Peace" and "Improvement of Scientific Education in China."

The members of these 7 Chinese scientific societies wish to place on record their unanimous opinion with respect to (1) the control of atomic energy and (2) the development of scientific research in China:

(1) "We feel that the probing into the mysteries of atomic energy, like scientific research work in all other fields, should have as its objective the promotion of human welfare. The atomic nucleus was successfully cracked at a time when the democracies were locked in a life-and-death struggle with the totalitarian states. Quite naturally it was taken advantage of in the making of weapons of war. This is a misfortune for atomic energy and also for scientific research. Now that the war has been concluded and the democracies are endeavoring to bring about world cooperation, it is our conviction that atomic research should be freed from its closely guarded secrecy to be directed toward the advancement of world peace and welfare of the human races. We object to the application of achievements in atomic research for the manufacture of bombs and other weapons and emphatically to the competition in, or secrecy attached to, such manufacture, which threatens the friendly ties among democratic countries and jeopardizes the freedom of scientific research. Therefore we unreservedly pledge our support to the stand of the Association of Science for Atomic Education and the Federation of American Scientists.

(2) "We Chinese as a race are still facing starvation and other acute shortages in this atomic age, backwardness in the development of science being one of the causes. The significance of scientific development lies in its power to raise proportionately the standard of living. We have never before given sufficient emphasis to the fundamental sciences and cannot hope suddenly to acquire a mature status in scientific work by the importation of a few instruments for atomic studies. We must lay the foundations first by the strengthening of the physical equipment for science education and by extending adequate facilities and stable living conditions to our teaching and research personnel. What is more important, we should adopt a definite and

long-range plan for the development of scientific undertakings with the necessary budgets to carry it out to the fullest extent. The discontinuation of the YVA project shortly after its inception is an example that we hope will not be repeated. If we want science to serve as an important contributing factor in the reconstruction of the nation, we believe it must be made to stand on firmer ground. Scientific development cannot be bought ready made, as some people thought half a century ago that it could be in the form of firearms and gunboats."

Elections

United Engineering Trustees, Inc., at its annual meeting October 23 in the Engineering Societies Building, 29 West 39th Street, New York, elected J. Schuyler Casey, president, M. H. Treadwell Company, Inc., New York, as president; Gen. William H. Harrison, chief engineer, American Telephone and Telegraph Company, New York, and director, Procurement and Distribution Service, Office of Chief Signal Officer, Washington, D. C., as vice-president; Edward C. Meagher, assistant to the president, Texas Gulf Sulphur Company, New York, as vice-president; Kurt W. Jappe, retired director of purchases, Hercules Powder Company, Wilmington, Delaware, as treasurer; James L. Head, Department of Mines, Chile Exploration Company, New York, as assistant treasurer; and John H. R. Arms was re-elected secretary.

At the 20th annual meeting of the Texas Archaeological and Paleontological Society, October 25, Cyrus N. Ray, Abilene, Texas, was elected president for the 20th consecutive year; Tom N. Campbell, Austin, was elected vice-president; Earnest Wallace, Lubbock, secretary-treasurer; and W. C. Holden, Lubbock, editor of publications. Other officers elected included Alex Krieger, Austin, Rupert N. Richardson, Abilene, and Joe Ben Wheat, Tucson, Arizona, as directors, 8 regional vice-presidents, and 8 trustees.

The Ohio Branch, Society of American Bacteriologists, elected the following officers at its Autumn Conference October 25 on the Ohio State University campus: Orton K. Stark, Miami University, president; John Dingle, Department of Preventative Medicine, Western Reserve University, vice-president; and H.

H. Weiser, Department of Bacteriology, Ohio State University, secretary-treasurer. Robert Parker, College of Medicine, Western Reserve University, was elected consular to the Society of American Bacteriologists, and Lloyd C. Ferguson, Department of Bacteriology, Ohio State University, member of the Policy Committee.

The Engineering Foundation, at the annual meeting of its Board, October 16, in the Engineering Societies Building, New York, elected as officers for the coming year: A. B. Kinzel, vice-president, Union Carbide and Carbon Research Laboratories, Inc., chairman; L. W. Chubb, director, Westinghouse Research Laboratories, vice-chairman; Edwin H. Colpitts, formerly vice-president, Bell Telephone Laboratories, director; and John H. R. Arms, secretary. Newly appointed to the Executive Committee were: George L. Knight, formerly vice-president, Brooklyn Edison Company; and Joseph W. Barker, president, Research Corporation.

NRC News

The name "Committee on Aviation Psychology" has been substituted for "Committee on Selection and Training of Aircraft Pilots" to designate a committee of the Division of Anthropology and Psychology which has conducted research in the field of aviation psychology since 1939. As in the past, the work of the Committee is supported with funds allotted by the Civil Aeronautics Administration, although steps have recently been initiated to undertake research for other government agencies.

The Committee has from its very beginning conducted research involving the maintenance as well as the selection and training of aircraft pilots. Among the more than 70 reports published by the Committee in the Technical Series, Division of Research, Civil Aeronautics Administration, there are many which are concerned with the psychological aspects of fatigue, accidents, air sickness, etc. The change in name, which has been under consideration for some time, has been made in order to describe Committee functions more accurately.

The current research program of the Committee on Aviation Psychology, which is largely concerned with air transport pilots and, most particularly, with human factors in airplane accidents, includes

research on the selection, upgrading, and certification of pilots; studies of stall-warning devices; psychological aspects of instrumentation; and investigation of methods of training civilian and commercial pilots. Such research is being conducted through The Ohio State University, the American Institute for Research, the Educational Research Corporation, and other agencies. The Executive Subcommittee will be pleased to consider proposals for grants-in-aid to research personnel working in universities and other institutions who are interested in carrying out investigations in the field of aviation psychology under the auspices of the Committee. Proposals should be submitted to: M. S. Viteles, Chairman, National Research Council Committee on Aviation Psychology, University of Pennsylvania, Philadelphia, Pennsylvania.

The present membership of the Committee includes: Brigadier Gen. Milton W. Arnold, vice-president, Operations & Engineering, Air Transport Association of America; Cdr. Norman L. Barr, Division of Aviation Medicine, Bureau of Medicine & Surgery, Navy Department; George K. Bennett (*ex officio*), president, Psychological Corporation; D. R. Brimhall, assistant to the Administrator for Research, CAA; Paul M. Fitts, chief, Psychology Branch, Aero Medical Laboratory, Wright Field; Frank A. Geldard, professor of psychology, University of Virginia; Capt. B. Groesbeck, Division of Aviation Medicine, Bureau of Medicine & Surgery, Navy Department; Major Gen. Malcolm C. Grow, Air Surgeon, Army Air Forces; George E. Haddaway, editor, *Southern Flight*, Air Review Publishing Corporation; A. I. Hallowell (*ex officio*), chairman, Division of Anthropology and Psychology, and professor of anthropology, University of Pennsylvania; J. G. Jenkins, head, Department of Psychology, University of Maryland; Capt. Wilbur E. Kellum, U. S. Navy, School of Aviation Medicine, Pensacola, Florida; Peter C. Kronfeld, associate professor of ophthalmology, and director of education, Illinois Eye and Ear Infirmary, University of Illinois; Jerome Lederer, chief engineer, Aero Insurance Underwriters; Donald B. Lindsley, professor of psychology, Northwestern University; W. R. Miles, professor of psychology, School of Medicine, Yale University; C. L. Shartle, professor of psychology, The Ohio State University; Lt. Col. Anthony C. Tucker, Office of the

Air Surgeon, Headquarters, Army Air Forces; and M. S. Viteles (chairman), professor of psychology, University of Pennsylvania.

Cdr. Barr, Drs. Bennett, Brimhall, Fitts, Geldard, Hallowell, Lindsley, and Viteles, and Capt. Kellum and Lt. Col. Tucker make up the Executive Subcommittee.

Recent Deaths

Erik Lysholm, 55, Swedish radiologist who produced the first "precision skull apparatus" and who also contributed the so-called "fixed" or "Swedish grid," died in Stockholm September 26.

Mrs. David R. Merrill, 52, died October 8 at Burlington County Hospital, Mt. Holly, New Jersey.

George W. Willson, 57, dean, Marquette University Dental School, died in Milwaukee November 11, after a long illness.

Clovis Vincent, 68, chief, Neurosurgical Services, Pitie Hospital, Paris, France, and a noted brain surgeon, died November 14.

George Grant MacCurdy, 84, professor emeritus of anthropology, Yale University, and retired director, American School of Prehistoric Research, Washington, D. C., was fatally injured November 15, when he was struck by an auto while crossing the road on Route 29, near North Plainfield, New Jersey.

William M. Mallisoff, 52, director, Longevity Research Foundation, New York City, and formerly associate professor of biochemistry, University of Pennsylvania, and Brooklyn Polytechnic Institute, died November 16 at his New York home after a day's illness. Dr. Mallisoff had edited *Philosophy of Science* since 1934.

A Mission on Science and Technology will soon be established in the U. S. Embassy in London. According to a joint White House and Department of State release, the Mission staff will be a small one, headed by **Earl A. Evans, Jr.**, chairman, Department of Biochemistry University of Chicago. These scientists and engineers will be assigned for short-

term periods on a rotating basis. Main duty of the Mission will be to supply interested individuals and agencies in Great Britain information concerning current developments in such fields as organic chemistry, biochemistry, physics, engineering, biology, and agronomy, and to collect similar information on British developments for dissemination to government agencies and scientific societies in this country. Specifically, the Mission will also assist in facilitating exchange of scientific personnel, develop and continue close personal contact with government agencies and research institutions in the United Kingdom, answer inquiries about particular developments in Great Britain originating in this country, and stimulate exchange of reports of a scientific and technical nature. Such an arrangement was recommended by John R. Steelman, special assistant to the President, in his series of reports entitled *Science and public policy*. The British have for some time maintained in the United States the British Commonwealth Scientific Office, which has proved extremely successful. In a letter to the Rt. Hon. Herbert Morrison, Lord President of the Council, London, dated October 30, Mr. Steelman, in announcing the proposed establishment of the Mission, stated that "an exchange of ideas and information, in accordance with the freedom that has always characterized the relations between scientists in our two countries, should result in substantial benefits not only to specialists in the fields of science, medicine, and engineering, but to all citizens in both our Nations."

The Committee on Russian Literature of the Geological Society of America has begun the compilation of a list of translations of geologic papers and books from Russian into English—that is, a list of translations extant in manuscript form in the United States. The readers of *Science* are requested to send information concerning any such translations to the committee chairman, Ronald E. DeFord, Box 1814, Midland, Texas, or to Geological Society headquarters, 410 West 117th Street, New York 27, New York. The word *geologic* is used here in its widest sense to extend inclusively from geophysics to paleontology.

If information about translations of recent publications is received soon enough, it will be included in forthcoming volumes of the *Bibliography and index*

geology exclusive of North America and the *Bibliography of economic geology*, subject to permission from proprietors of translations.

The National Applied Mathematics Laboratories, which sprang from the realization by the Office of Naval Research in 1946 of an urgent need for a national center where facilities and staff would be available to develop and use new high-speed computing machines in service to the field of applied mathematics, has now been established as a division of the National Bureau of Standards. The center is headed by **John H. Curtiss**, formerly director's assistant in applied mathematics at the Bureau. The work of the new division, concentrating on mathematical statistics as applied to the physical and engineering sciences, will be carried on with the advice of an Applied Mathematics Council made up of representatives from interested government agencies and private organizations.

Within the new center are four separate laboratories: the Institute of Numerical Analysis, on the campus of the University of California at Los Angeles, which, under the auspices of the Office of Naval Research, will do research and training in mathematical fields best suited to the use and development of high-speed automatic digital computing machines, and also provide computing service for local groups; the Computation Laboratory, headed by **Arnold N. Lowan**, formerly technical director, Mathematical Tables Project, and also underwritten by ONR, which will continue the work of the Mathematical Tables Project and provide a computing service for use by private industry, government agencies, and educational and research institutions; the Statistical Engineering Laboratory, headed by **Churchill Eisenhart**, formerly senior staff member, Statistical Research Group, Columbia University, which will provide a consulting service on methods of statistical inference as applied to engineering and physical sciences for government and private agencies, and training in the theory of statistics; and the Machine Development Laboratory, headed by **E. W. Cannon**, statistical engineering officer, Bureau of Ships, which will develop and construct the new computing machinery according to the specifications set forth by the other laboratories, the Office of Naval Re-

search, the Bureau of the Census, and other government agencies.

The carnivorous Army Ants will be the subject of a study by a field group which left the American Museum of Natural History for Panama, November 4. **T. C. Schneirla**, curator, Department of Animal Behavior of the Museum, who heads the expedition, was accompanied by **Ernest Enzmann**, research associate in zoology, Massachusetts Institute of Technology, and **Robert Z. Brown**, graduate student of zoology, Swarthmore College. The group will spend 5 months on Barro Colorado Island in Gatun Lake and in the Darien country of eastern Panama. The Army Ant derives its name from its highly military society; it moves in colonies of 65,000 and more in long, narrow columns sometimes stretching out 300 yards. The ants move in regular cycles traveling nightly for 17 days and resting for 20. When on the move, they send out flanking columns for scouting and food securing. The field group hopes to discover how the ant colony queens are formed, and how and why the queen ants possess the ability to produce broods at regular intervals of 36 days throughout the year, all of these broods but one consisting of about 30,000 nonreproductive workers; the remaining brood consists of about 3,000 males born in the dry season. A brood containing queens may prove to be another exception.

From the waste pulp of the coffee bean comes a new corn-substitute cattle feed for milk production, developed through the cooperative effort of agricultural technicians of the United States and El Salvador. Tests under specific conditions have proved that the coffee pulp can be substituted, pound for pound, for corn as cattle feed for milk production. Coffee pulp is the fleshy covering of the bean and is largely a waste product, and although it has limited use as a fertilizer, its disposal has usually been a problem. In recent years the potential value of coffee pulp as a feed has been recognized by **Felix Choussy**, Instituto Tecnológico, El Salvador, and **R. L. Squibb**, formerly of the Inter-American Institute of Agricultural Science. Studies regarding the substitution of dried coffee pulp for corn in the ration of milk cows were conducted in El Salvador by **Samuel H. Work**, Office of Foreign Agricultural Re-

lations, and **Mario Lewy Van Severen**, chemist, and **Louis Escalon**, dairying technician, El Salvador. It has been found that the palatability of the pulp is increased by mixing it with banana leaves, molasses, or other feedstuff. Additional tests will be made at the U. S. Department of Agriculture's research center, Beltsville, Maryland, and at various other state experiment stations.

Marine life in the Bikini lagoon appears little changed by the atomic bomb radiations, according to the observations of **Leonard P. Schultz**, curator of Fishes, Smithsonian Institution, who has just returned from Bikini after taking part in the Bikini Scientific Resurvey carried out by the Navy Department in cooperation with the Army and other government agencies. Dr. Schultz explained that undoubtedly enormous numbers of fish and other marine organisms were killed by the bomb explosion, but their places have been filled by overpopulation pressure from outside the immediate explosion area, with the result that life seems about as abundant as ever. There was no observable sterility caused by the continued radioactivity, as various specimens were found spawning in normal fashion. Genetic effects or possible weaknesses from continued radiation are impossible to discern at this early date.

Make Plans for—

American Academy of Pediatrics, annual meeting, December 9, Dallas, Texas.

National Council of Geography Teachers, December 27-29, Charlottesville, Virginia.

American Society for Professional Geographers, December 27-30, Charlottesville, Virginia.

American Anthropological Association, December 28-31, Albuquerque, New Mexico.

American Astronomical Society, December 28-31, Ohio State University, Columbus, Ohio.

American Association for the Advancement of Science, 114th Meeting, December 26-31, Chicago, Illinois.

TECHNICAL PAPERS

Chemical Structure and the Definition of Sympathin E¹

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Cannon (2), in 1940, had come to the conclusion that the chemical substance liberated from sympathetic (adrenergic) nerves and responsible for activating the effectors they innervate was, indeed, as Elliott (4) had speculated and Loewi (8) has long claimed, adrenaline and identical with the secretion of the adrenal medulla.

In studying the relation of chemical structure to the action of sympathomimetic amines we have found it necessary to develop a more discriminating and sensitive method than has been available for the quantitative determination of the inhibitory properties (12). For this purpose we have utilized the inhibitory effect of sympathomimetic amines on transmission at synapses in sympathetic ganglia described by one of us in 1939 (10, 11). We have recently emphasized that in these effects we are dealing with an initial and primary adrenergic inhibition and not some sequela of excitation (13).

Synaptic transmission was maintained at a control level by applying electrical stimuli of constant intensity to the pre-ganglionic nerves and recorded by registering the resulting

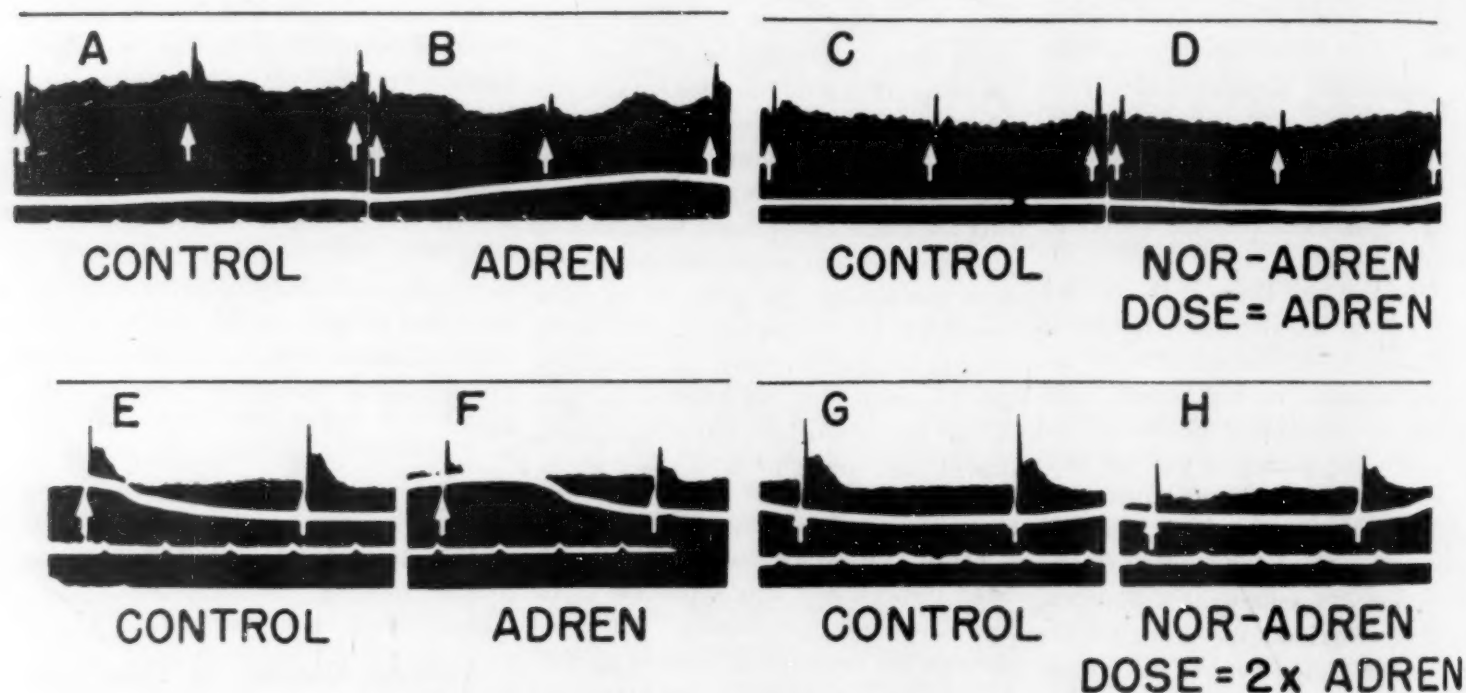


FIG. 1. Comparison of ganglionic inhibitory activity of adrenaline and nor-adrenaline.

Cannon and Rosenblueth (3) had previously demonstrated that the substance liberated by adrenergic nerves was further elaborated in the effectors and that, under conditions of excessive stimulation, the new product formed overflowed and appeared in the blood stream as a substance possessing either purely excitatory or purely inhibitory properties, depending on whether it was formed in an excited or an inhibited effector. In this manner they defined sympathin E and sympathin I.

Since the sympathins are derived in the first instance from the adrenaline (or adrenaline-like substance, cf. Euler, 5) liberated from nerves but possess only a part of adrenaline's actions, many hypotheses have been advanced as to the composition and manner of formation of the degradation product. Demethylated adrenaline (nor-adrenaline) has been a favorite candidate for the role of sympathin E (1, 5, 6, 7).

postsynaptic action potentials from the postganglionic nerves by suitable high-gain amplifiers (9). With the ganglionic circulation intact, a drug injected intravenously readily gains access to the ganglionic synapses and manifests its inhibitory effect by a reduction in the height of the postsynaptic potentials.

In this way, as illustrated in Fig. 1 B and D, which show the effects of intravenously injected equimolar quantities of adrenaline and nor-adrenaline³ on the superior cervical sympathetic ganglion of the cat anesthetized with nembutal,⁴ it can readily be seen that nor-adrenaline has a considerable inhibitory effect, in fact, as much as one-half the inhibitory power of adrenaline (F, H). Since these synapses are adrenergic—and furthermore can fairly be considered as representative of adrenergic junctions in general (12)—this disqualifies

¹ This research was conducted with the assistance of a grant-in-aid from the U. S. Public Health Service.

² Smith, Kline & French fellow.

³ We wish to thank C. M. Greer for supplying us with nor-adrenaline.

⁴ Nembutal was kindly furnished by Abbott Laboratories.

nor-adrenaline from being sympathin E unless we depart from Cannon and Rosenbluth's definition of sympathin E as a purely excitatory substance without inhibitory action. We must conclude, therefore, that neither nor-adrenaline nor any of the other sympathomimetic amines in the series of 21 compounds we have studied in this fashion (to be reported in detail elsewhere) can be sympathin E. An alternative would be to regard sympathin E as a substance that is only predominantly rather than purely excitatory.

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Microbial Utilization of Carcinogenic Hydrocarbons¹

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Recent investigations reveal that microorganisms of marine origin may be capable of decomposing carcinogenic hydrocarbons associated with the production of tumors in animals.

That many microorganisms possess the ability of utilizing hydrocarbons as a sole source of energy in their metabolism has been previously demonstrated and confirmed (2). Nearly 100 species of bacteria, yeasts, and molds representing 30 genera have been shown to attack various hydrocarbons of the gaseous, liquid, and solid state, and in the aliphatic, olefinic, naphthenic, and aromatic series. Such organisms have been found widely distributed in nature, from terrestrial as well as marine sources. The list of hydrocarbons which have been found to be subject to microbial attack is rapidly growing.

The current studies on microbial utilization of carcinogenic hydrocarbons are incidental to a comprehensive survey of the role of bacteria in the decomposition and diagenesis of petroleum hydrocarbons and related compounds. However, the widespread interest in cancer research and the obvious need for mutual cooperation among all scientific workers who may be concerned, directly or indirectly, with such a vital problem relating to public health suggest that these findings be presented apart from those pertaining to petroleum genesis.

Included among the compounds used as substrates were naphthalene, anthracene, phenanthrene, diaminobenzene, 1,2-benzanthracene, and 1,2,5,6-dibenzanthracene. The

latter two are listed in a recent survey published by the U. S. Public Health Service (1) as having induced tumors in experimental animals. Like the majority of the carcinogenic compounds listed in this survey, the 6 which were investigated are aromatic cyclic or polycyclic hydrocarbons containing one or more benzene rings, (Fig. 1). Chemically and physically they are stable and refractory compounds with low solubilities or, as is the case with 1,2-benzanthracene and 1,2,5,6-dibenzanthracene, insoluble in water and the organic solvents commonly used in the laboratory.

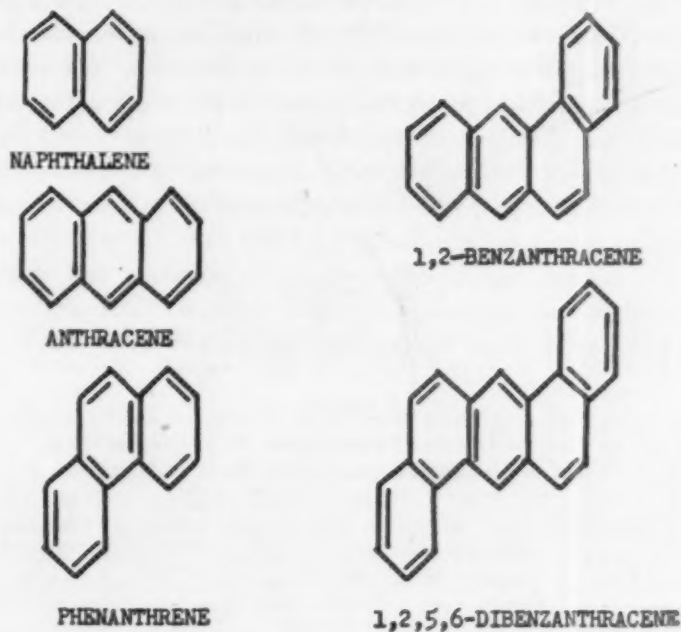


FIG. 1

The organisms used in the experiments were of marine origin. For the purpose of demonstrating the utilization of the carcinogenic and related hydrocarbons by the cultures, an apparatus was employed which measured the amount of carbon dioxide evolved by the cultures upon oxidation of the substrate. Other methods for determining the rate of oxidation have been successfully used, however, including the measurement of oxygen uptake, both manometrically and by the Winkler method (3).

The 6 compounds tested were dispersed in ignited sand to provide suitable surface area for the organisms. Two of the compounds, 1,2-benzanthracene and 1,2,5,6-dibenzanthracene, which are solid compounds at room temperatures and insoluble in water and organic solvents, were ground to a fine powder in a mortar, which favored a more intimate contact between the organisms and the substrate. Naphthalene, anthracene, and phenanthrene were first dissolved in volatile solvents and then precipitated as a thin film on ignited sand by evaporating off the solvent.

After the ignited sand and substrate were added to the culture receptacles, the only additional substance used besides the inoculum was the suspension medium. For this purpose, filtered sea water containing 0.1 per cent $(\text{NH}_4)_2\text{HPO}_4$ was used. This had been previously aged for several months in the dark at a temperature favoring the removal of dissolved organic matter present. Sea water is a physiologically balanced solution and contains all the essential salts necessary to satisfy the mineral requirements of marine organisms.

The controls used in these experiments included, for the most part, those which precluded false positive readings which

¹ Contribution from the Scripps Institution of Oceanography, New Series 348. This paper is a contribution from the American Petroleum Institute, Research Project 43A.

might result from the possible introduction of adventitious organic matter in the substrate, inoculum, suspension medium, glassware, and connections in contact with the incubating cultures, plus controls to measure endogenous metabolism. The cultures, together with 25 mg. of hydrocarbon substrate, ignited sand, and sea water, were incubated at 32° C. for four days with the controls, during which time a stream of carbon dioxide-free air was bubbled through the culture receptacles at the rate of 50 ml./minute. The carbon dioxide evolved from the oxidation of the substrate and from endogenous metabolism was collected in N/10 NaOH during the incubation period. The residual carbon dioxide remaining in the solution after incubation was driven off by acidification. The endogenous control served also to eliminate the effect of carbon dioxide (as dissolved carbon dioxide, bicarbonate, and carbonate) present in the sea water other than that evolved by metabolic processes, which would be flushed into the caustic solution upon acidification.

The carbon dioxide collected at the receiving end of the apparatus was determined by back titration. That produced by the endogenous control was subtracted from the total

TABLE 1

AMOUNT OF CARBON DIOXIDE PRODUCED BY ACTION OF BACTERIA ON 25 MG. OF HYDROCARBONS IN FOUR DAYS AT 32° C.

Hydrocarbon	CO ₂ produced (mg.)	Amount oxidized (%)
Naphthalene	44.2	51
Anthracene	53.5	64
Phenanthrene	58.5	68
Diaminobenzene	14.0	23
1,2-Benzanthracene	41.2	47
1,2,5,6-Dibenzanthracene	11.6	13
None (Control)*	0	—

* The controls used as checks against introduction of adventitious organic matter produced less CO₂ than the endogenous controls, hence are condensed as one control shown here.

carbon dioxide produced by the culture acting on the substrate to give the net amount of hydrocarbon oxidized by the organisms (Table 1). Since the empirical formulas and molecular weights of the hydrocarbons under test are known, the per cent oxidation of 25 mg. of the substrate was computed.

In view of the high oxidation rates, it does not seem unlikely that a quantitative oxidation of the carcinogenic hydrocarbons could be effected with a longer incubation period.

It is not contemplated that current investigations of the microbial utilization of carcinogenic hydrocarbons will continue beyond a brief survey of those compounds of particular structural interest. The findings from these cursory investigations have been presented with the hope of stimulating further research into the possible application of bacteria or their products in the prophylactic or therapeutic treatment of cancer.

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Effect of Indole on the Determination of N'-Methylnicotinamide

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The fluorometric method for determining the amounts of N'-methylnicotinamide in urine, which has been widely used, has been particularly valuable for measurements of N'-methylnicotinamide in the urine after the test animal has been fed tryptophane or related compounds (e.g. 4, 5, 6, 8). In studies conducted in our laboratory (6, 7) measurements of N'-methylnicotinamide have been carried out without hydrolysis of the urine samples by the method of Huff, *et al.* (2). During the course of investigations on the effect of vitamin B₆ deficiency on the apparent conversion of tryptophane to nicotinic acid, it was of interest to determine the influence of feeding indole to rats on the amounts of N'-methylnicotinamide and nicotinic acid excreted in the urine.

TABLE 1

EFFECT OF FEEDING INDOLE TO RATS ON MEASUREMENT OF N'-METHYLNICOTINAMIDE AND NICOTINIC ACID IN THE URINE

(Values expressed as µg. excreted/rat/day)

Experimental series	Feeding regimen for indole					
	Before	During	After	Before	During	After
	N'-Methylnicotinamide			Nicotinic acid		
A	335	597	281	37	10	27
B	71	380	81	25	27	39
C	78	523	67	33	40	32
D	63	450	79	39	37	41
E	80	323	55	37	36	49
F	400	630	243	34	62	52
G	191	351	135	30	12	18
H	—	273	159	36	15	23
Average...	194	448	152	33.8	25.9	32.6

When a purified ration, adequate in vitamin B₆ but devoid of added nicotinic acid, was fed, the rats fed 100 mg. of dl-tryptophane/day excreted large amounts of N'-methylnicotinamide and nicotinic acid (6). However, when the rats were fed 50 mg. of indole/per day, a definite, though smaller, rise in N'-methylnicotinamide, but no increase in the amount of nicotinic acid, was observed. In fact, a slight reduction was noted in the average amount of the latter excreted (Table 1). This observation can be explained partially on the basis of a lower food consumption during the period when indole was added to the ration. In this work the same experimental regimen and analytical procedures were used as in earlier work (6).

These observations and those obtained on the ineffectiveness of indole in stimulating the growth rate of rats fed rations low in nicotinic acid (3; unpublished data) suggested that indole was not being utilized to form nicotinic acid derivatives, but was interfering with the fluorometric determination of N'-methylnicotinamide. To test this possibility, samples of urine from rats fed indole were extracted with ether to remove indole and some related compounds (1) prior to the estimation of

¹ The technical assistance of Patricia Sparks is gratefully acknowledged.

N'-methylnicotinamide. In addition, the effect of indole, tryptophane, and anthranilic acid on the measurement of N'-methylnicotinamide was determined, and the effect of indole was also tested in the presence and absence of urine. Some of these results are shown in Table 2.

Indole tested in the absence of urine showed some fluorescence measured as N'-methylnicotinamide. The fluorescence observed was equivalent to 12.2, 9.0, and 6.0 μ g. of N'-methylnicotinamide when 1,000, 750, and 500 μ g. of indole were tested. This effect could be eliminated by ether extraction of the indole solutions prior to the estimation of N'-methylnicotinamide. Anthranilic acid or tryptophane failed to show this interference, in that no fluorescence was observed when 1 mg. or more of these compounds was tested. It is readily apparent, therefore, that indole does interfere with the determination of N'-methylnicotinamide to a small extent, and this effect can largely be eliminated by the ether extraction procedure. Ether extraction of urine from rats fed indole reduced the values for N'-methylnicotinamide somewhat (Table 2), but did not reduce them to an extent whereby the

of the interfering substances formed when indole is fed. The possibility, however, that when indole is fed some increase does occur in the amount of N'-methylnicotinamide excreted cannot be unequivocally ascertained. Furthermore, the large increases noted in the amounts of N'-methylnicotinamide and other nicotinic acid derivatives excreted when tryptophane is fed may be due, to a slight extent, to the presence of interfering compounds in the urine not extractable by ether. This possibility has also been recognized by other workers (8). No evidence has been obtained to suggest that indole or related compounds interfere with the microbiological determination of nicotinic acid. These observations indicate that the significance of the small rise noted in the amounts of N'-methylnicotinamide excreted when indole was fed is questionable.

Further work in identifying urinary nicotinic acid metabolites and refinements in methods for their estimation will be helpful in elucidating the metabolism of nicotinic acid and its relationship with other dietary nutrients.

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Production of Starch-like Material From Glucose-1-phosphate by Diphtheria Bacilli¹

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This paper deals with the production of starch-like material from glucose-1-phosphate by *Corynebacterium diphtheriae* and some streptococci. The occurrence of starch-phosphorylases in yeast and in plant and animal tissues is well known, but, apart from our observation (1) that some strains of *Neisseria perflava* which form an amylopectin-like material from sucrose also form small amounts from glucose-1-phosphate, the capacity of bacteria to convert glucose-1-phosphate to products of the starch class has not previously been reported.

The bacteria tested in the present experiments included 17 strains of *C. diphtheriae* (12 had been recently isolated), 12 strains of streptococci Lancefield groups A to F, 9 strains of streptococci from endocarditis which form dextran from sucrose (2), and representatives of various other species of medical interest; for purposes of comparison, 3 strains of *N. perflava* were also included. The bacteria were inoculated into 3 mediums containing 2 per cent glucose-1-phosphate (crystal-

¹ This work was aided by a grant from the Sugar Research Foundation, Inc.

TABLE 2

EFFECT OF INDOLE ON THE APPARENT URINARY EXCRETION OF N'-METHYLNICOTINAMIDE BY THE RAT
(Values expressed as mg./ml. of urine)

Urine collection (No.)	Diet fed	Apparent excretion of N'-methylnicotinamide	
		Not ether extracted	Ether extracted
58	Basal ration	1.87	1.81
65	" "	4.02	4.00
66	" "	3.68	3.68
47	Basal + 50 mg. of indole/day	3.59	3.08
48	" " " " " "	2.94	2.41
51	" " " " " "	4.90	4.52
52	" " " " " "	6.70	6.65
24	Basal ration + 100 mg. of dl-tryptophane/day	21.6	20.9
25	" "	20.1	19.8
26	" "	16.9	17.2
27	" "	16.2	17.9
24a	Basal ration + 100 mg. of dl-tryptophane/day + indole*	25.4	22.7
25a	" "	23.6	20.2
26a	" "	16.9	16.3
27a	" "	19.0	17.5

* In these tests 40 μ g. of indole were added to each ml. of urine prior to estimations of N'-methylnicotinamide in each sample with and without ether extraction.

effect of feeding indole on the amounts of the methylated derivative found in the urine was negated. Control tests conducted with urine from rats fed the basal diet or basal diet plus tryptophane showed no reduction attributable to ether extraction of the samples. Similarly, N'-methylnicotinamide was not extracted by ether. Thus, it appears that extracting urine samples with ether removes only a portion

line dipotassium salt), 2 per cent glucose, or 2 per cent sucrose; the base was 1 per cent tryptose, 0.3 per cent yeast extract, 0.5 per cent NaCl, and 0.05 per cent glucose; for the meningococci and gonococci, 0.2 per cent agar was added. After incubation at 37° C. for 7 days, the cultures which had good growth in all the mediums were centrifuged, and the supernatant fluids and the bacterial sediments were tested separately for starch-like material by observation for dark coloration upon addition of a solution containing 0.02 per cent I₂ and 0.2 per cent KI.

The chief point (Table 1) is that all the strains of *C. diphtheriae* produced material which gave a dark-blue to purple color with iodine when grown in the medium containing glucose-1-phosphate; the iodine-coloring material was readily demonstrable in the supernatant fluids as well as in the bacterial sediments. The same capacity was shown by some of the streptococci, but it did not occur regularly among the varieties which we tested; for example, only one of 5 group A, 2 of 3 group C, and 2 of the 9 dextran-forming streptococci gave a positive reaction. Except for the *N. perflava*, none of the other

TABLE 1

TESTS ON CULTURES GROWN IN BROTHS CONTAINING GLUCOSE-1-PHOSPHATE, GLUCOSE, OR SUCROSE

Bacteria	No. of strains tested	Dark color with iodine*		
		GP	G	S
<i>C. diphtheriae</i>	17	17	0	0
<i>Streptococcus</i> , groups A-F.....	12	4	0	0
" , others†.....	9	2	0	0
Other bacteria†.....	40	0	0	0
<i>N. perflava</i>	3	1	0	3

* GP = glucose-1-phosphate; G = glucose; S = sucrose.

† Strains from subacute bacterial endocarditis which form dextran from sucrose (2).

‡ Included 3 diphtheroids, 3 staphylococci, 7 gonococci, 2 meningococci, 3 *E. typhosa*, 2 *Salmonella*, 3 *Shigella*, 1 *Bact. coli*, 2 *Bact. aerogenes*, 2 *Bact. Friedlanderi*, 2 *Proteus*, 1 *Ps. pyocyanea*, 1 *Cl. tetani*, 1 *Cl. histolyticum*, 2 *B. anthracis*, and 5 *B. subtilis*.

bacteria tested produced any detectable amount of iodine-coloring material, but the number of strains included are too small to warrant any conclusions on the entire lack of the capacity in any of those species. That all the 17 strains of *C. diphtheriae* and none of the 3 diphtheroids which we tested had the capacity raises the question of the possible use of tests for the production of starch-like material from glucose-1-phosphate as a descriptive, and perhaps as a differential, feature for *C. diphtheriae*.

The formation of starch-like material by *C. diphtheriae* apparently belongs to the same general class of reactions as those brought about by the starch-phosphorylases of tissue origin. As shown in Table 1, glucose-1-phosphate serves as substrate, and sucrose and glucose do not. Furthermore, in experiments which we have made with mixtures of resting cells plus glucose-1-phosphate, formation of polysaccharide occurred and was accompanied by an increase in inorganic phosphate and a corresponding loss in organic bound phosphate; also, the polysaccharide production was inhibited by high concentrations of inorganic phosphate. Although its chemical study has not been completed, the bacterial product has been found to be a mixture of amylose-like and amylopectin-like

polysaccharides, and in that respect it can be regarded as material similar to the starches formed by many plants.

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Vitamin Requirements of *Microbacterium lacticum* Orla-Jensen

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Investigations in progress on the metabolism and taxonomic position of bacteria in the genus *Microbacterium* Orla-Jensen (1) have shown that d-calcium pantothenate constitutes an essential nutritional requirement for some strains of *Mbm. lacticum*. In addition, thiamine was identified as one of the vitamins exerting a stimulatory effect upon growth.

TABLE 1

COMPOSITION OF BASAL MEDIUM

Glucose, c.p.....	1.0 gram
Casein hydrolysate, vitamin-free.....	0.5 "
K ₂ HPO ₄ , c.p.....	0.2 "
KH ₂ PO ₄ , c.p.....	0.2 "
d-Calcium pantothenate.....	100.0 γ
Thiamine hydrochloride.....	100.0 γ
Distilled water to make.....	100.0 ml.
pH 6.6 ± 0.1	

Preliminary experiments indicated that several strains of *Mbm. lacticum* would grow in a medium consisting of inorganic salts, glucose, vitamin-free hydrolyzed casein,¹ and a combination of most of the known bacterial vitamins. By a process of elimination it was found that a medium of the composition listed in Table 1 and designated as the basal medium would support growth of most strains tested.

TABLE 2

EFFECT OF D-CALCIUM PANTOTHENATE AND THIAMINE ON THE GROWTH OF *Mbm. lacticum*

Composition of medium	Strain designation						
	0J3	1PM1	1PM3	3RM2	3RM3	8180	S1
Basal minus d-Ca pantothenate and thiamine.....	0*	0	0	0	0	0	0
Basal minus d-Ca pantothenate.....	0	0	0	0	0	0	0
Basal minus thiamine.....	16	30	29	22	25	19	6
Basal medium.....	29	40	44	41	46	38	40

* Percentage of light absorbed through 10 ml. of medium measured with a Fisher Electrophotometer AC model, using filter 425 (blue). Readings after 4 days at 30° C.

A solution of the vitamin-free casein hydrolysate, neutralized to pH 6.6 ± 0.1, and solutions of glucose and phosphate salts were prepared and sterilized individually by autoclaving 15 minutes at 121° C. The d-calcium pantothenate and thia-

¹ A vitamin-free hydrolyzed casein designated as Lot #6 and obtained through the courtesy of M. L. Speck, National Dairy Research Laboratories, Baltimore, Maryland.

thiamine hydrochloride were sterilized individually by filtration through a Jena 1G5 auf 3 glass filter. Appropriate volumes of these ingredients were mixed together and then added to sterile test tubes in 10-ml. amounts, so that the final concentrations were as indicated in Table 1.

The inoculum for the basal medium was prepared in the following manner: Five ml. of a 4-day culture grown in yeast-extract-proteose-peptone-glucose broth (30° C.) was centrifuged and the sedimented cells washed with 5 ml. of 0.85 per cent saline. This was again centrifuged and the cells resuspended in 5 ml. of 0.85 per cent saline. One loopful of this suspension served as the inoculum for 10 ml. of basal medium. Ten of 14 strains of *Mbm. lacticum* were capable of growing on repeated subculture in the medium described in Table 1. The 4 strains which did not grow in this medium also failed to grow when most of the known bacterial vitamins were supplied.

Further observations indicated that d-calcium pantothenate was absolutely essential for the initiation of growth. Thiamine hydrochloride, however, was not. The 10 strains which grew in the basal medium also grew, though rather poorly, when thiamine hydrochloride was omitted. The effect of elimination of d-calcium pantothenate and thiamine hydrochloride separately and together on several representative strains is shown in Table 2.

The typical growth response of 4 strains of *Mbm. lacticum* to graded amounts of d-calcium pantothenate after 4 days at 30° C. is presented in Fig. 1. The minimal amount of this compound necessary for initiation of growth for most strains studied was approximately 0.02γ/ml., and maximum effect was usually obtained at a concentration of 0.1γ/ml. The re-

sponse to thiamine hydrochloride was not linear in concentrations of 0.01-1.0γ/ml.

The results presented indicate that under the described conditions d-calcium pantothenate and thiamine hydrochloride are nutritional requirements for most strains of *Mbm. lacticum* used in this study.

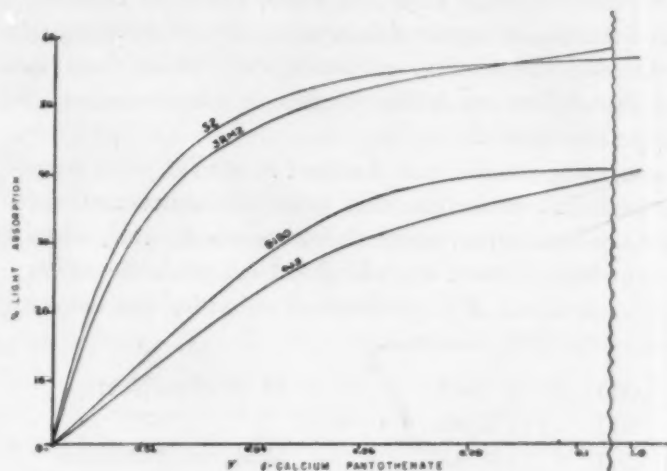


FIG. 1

Total growth in the basal medium as determined in these experiments was less than that in the natural medium, which indicates that an additional factor or factors are required for optimum growth.

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IN THE LABORATORY

A Rapid Method for Estimation of Use-Dilution Concentrations of Quaternary Ammonium Germicides

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The increased use of quaternary ammonium germicides as sanitizing agents for eating and drinking utensils, dairy and food processing equipment, etc., has accentuated the need for a satisfactory, rapid "use-dilution" test for determining the concentration of active quaternary ammonium agents in rinse waters. Dubois (1) has recently prepared a comprehensive review and evaluation of the methods that have been proposed for the chemical analysis of this group of compounds. While most of these give reliable and accurate results, under carefully controlled titration procedures, there still remains a demand for a simple test which is rapid and requires no elaborate apparatus. Furthermore, of particular importance to the sanitary engineer and public health officer is a test not only involving the latter requirements but also providing a reasonably accu-

rate estimation of the bactericidally active concentration of quaternary ammonium germicide in the presence of inorganic and, in particular, organic matter.

It is generally recognized that many compounds of anionic nature, such as detergents and soaps, as well as proteinaceous substances, *i.e.* egg albumin, peptones, milk, serum, etc., are not compatible with the cationic quaternary ammonium germicides. This incompatibility is often evidenced by the appearance of a turbidity which varies in intensity with volumes and concentrations when the compounds are mixed. It was postulated, therefore, that it would be possible to arrive at a suitable volume and concentration of one of these incompatible substances, which when combined with a quaternary ammonium germicide, would give by the degree of turbidity a reasonably accurate indication of the concentration of the bactericidally active quaternary present in a solution.

For purposes of sanitation, most quaternary ammonium germicides are recommended for use in concentrations ranging from 166 ppm (1:6,000) to 250 ppm (1:4,000) (3). Thus, the objective of a rapid use-dilution test should be the demonstration of the presence or absence of such concentrations in the unknown solution.

In exploratory tests concentrations of 125, 166, 250, and 500 ppm of benzalkonium chloride (U.S.P. XIII) were prepared in water. To varying quantities of each of these concentrations were added varying amounts and different concentrations of several anionic detergents. The results of this study revealed, however, that the anionic substances failed to show any progressive differences in turbidity which could be correlated, within a reasonable degree of accuracy, with the concentration of quaternary ammonium germicide with which they were mixed. For this reason, further studies on anionic reagents did not appear warranted.

Encouraging results were obtained in studies using normal horse serum in combination with germicidal concentrations of quaternary ammonium compounds. As an example, when 1 drop of undiluted serum was added to 1-ml. quantities of varying concentrations of benzalkonium chloride, the following degrees of turbidity resulted:

1,000 ppm (1:1,000)	++++	Marked turbidity
500 " (1:2,000)	++++	" "
250 " (1:4,000)	++	Moderate turbidity
166 " (1:6,000)	+	Trace
125 " (1:8,000)	--	No turbidity

With the evidence obtained in the turbidimetric analysis of benzalkonium chloride, the investigation was extended to include the several other quaternary ammonium compounds of different structural configurations. By using a constant volume of 1 drop of horse serum, as before, results comparable to those noted in the benzalkonium tests were obtained with *n*(acyl-colaminoformylmethyl)-pyridinium chloride, *p*-tertiaryoctyl-phenoxyethoxyethylmethylbenzylammonium chloride, cetylpyridinium chloride and 9-octadecenyldimethylethylammonium bromide. The test for turbidity in all instances was read at a 15- to 30-second time interval following the addition and shaking of the horse serum in the unknown quaternary ammonium solutions. A moderate to heavy turbidity developing within the time indicated is taken as evidence that the sanitizing solution contains at least 250 ppm (1:4,000) of quaternary ammonium germicide. The addition of 10 per cent aqueous safranin (prepared from a saturated alcoholic solution), to give a final concentration of 4 per cent in the horse serum, will facilitate the ease in reading the degrees of turbidity, and chloroform will serve as a preservative for the serum.

The specificity of the test method in the presence of substances known to completely or partially neutralize the bactericidal action of quaternary ammonium germicides was carried out in the following manner: To an equal volume of 1,000 ppm (1:1,000) benzalkonium chloride was added a neutralizing agent. In the event a precipitate resulted in this combination, the mixture was clarified by filtration through paper. One drop of horse serum reagent was added to 1 ml. of the clear solution and the presence or absence of turbidity noted. For purposes of comparison, the mixtures were also tested by the Dubois modification of the Hartley-Runnicles colorimetric procedure (2). The results of this study are presented in Table 1.

Examination of the data reveals several pertinent points, among which are the following: (a) The colorimetric method on the unfiltered, turbid mixtures gives values which are consistently higher than the same solutions which have been filtered. While this may not directly indicate inactivation of the quaternary ammonium germicide, it is evidence of adsorption

of the compound on the inactivating agent. Since in all instances filtration of turbid mixtures is necessary in carrying out the turbidimetric method, this obviates testing adsorbed quaternary ammonium compounds. (b) Certain quaternary-inactivator combinations will react with the indicator in the colorimetric test to give color complexes ("off color") not associated with the assay. In no instance was there any evidence of a similar interfering action in the horse serum reagent test.

TABLE 1
COMPARISON OF HARTLEY-RUNNICLES (DUBOIS) COLORIMETRIC AND HORSE SERUM TURBIDIMETRIC METHODS FOR DETERMINATION OF QUATERNARY AMMONIUMS

Quaternary ammonium (1:1,000 + inactivating agents)	Colorimetric (ml. Duponol "C")	Turbidimetric (1 drop serum)
Soap 1:1,000 (unfiltered).....	1.5	---
" 1:1,000 (filtered).....	0.3	0
" 1:100 (unfiltered).....	No reaction	---
" 1:100 (filtered).....	No reaction	0
Santomerse 1:1,000 (unfiltered).....	1.0	---
" 1:1,000 (filtered).....	0.3	0
" 1:100 (clear).....	No reaction	0
Duponol "C" 1:1,000 (unfiltered).....	Off color	---
" " 1:1,000 (filtered).....	0.3	0
" " 1:100 (clear).....	No reaction	0
Egg albumin 1:1,000 (clear).....	2.4	+++
" " 1:10 (unfiltered).....	Off color	---
" " 1:10 (filtered).....	2.0	++
Evaporated milk 1:100 (unfiltered).....	2.3	---
" " 1:100 (filtered).....	1.6	++
" " 1:10 (unfiltered).....	1.8	---
" " 1:10 (filtered).....	0.6	Trace
Orange concentrate-undiluted (unfiltered).....	Off color	---
" " (filtered).....	Off color	Trace
Ice cream 1:10 (unfiltered).....	1.5	---
" " 1:10 (filtered).....	0.7	Trace
Horse serum 1:10 (unfiltered).....	2.5	---
" " 1:10 (filtered).....	1.5	Trace
" " 1:5 (unfiltered).....	Off color	---
" " 1:5 (filtered).....	3.2	0
" " 1:2 (unfiltered).....	Off color	---
" " 1:2 (filtered).....	Off color	0
Control		
Quaternary 1:1,000.....	4.2	++++
" 1:2,000.....	2.3	++++
" 1:2,000 (filtered).....	2.0	++++
" 1:4,000.....	1.2	++
" 1:6,000.....	0.7	0

"No reaction"—4.2 ml. or more of Duponol reagent results in no change in color.

"Off Color"—dye used in test reacts with color in agent.

---solution turbid; impossible to test.

0—no quaternary demonstrable.

++ to ++++—moderate to marked turbidity.

Colorimetric and turbidimetric control tests on the several inactivating agents, in the absence of quaternary, in no instance showed evidence of a positive reaction indicative for quaternary ammonium compound. These data, therefore, were deleted from the table. Evidence will be presented elsewhere on the sensitivity of the present method for several homolo-

gous series of bacteriologically active and inactive quaternary ammonium germicides.

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A Simple Device for Macroscopic Sectioning of the Brain

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The principle involved in the macrotome to be described is not original but was seen and used by one of us (R. F. B.) in a much more elaborate and expensive apparatus. We have been unable to discover any American firm which manufactures such a macrotome and have concluded that the one observed was of European make and, therefore, no longer obtainable. For this reason we designed and built an instrument along similar lines, but much simpler and less expensive, which has proved entirely satisfactory.

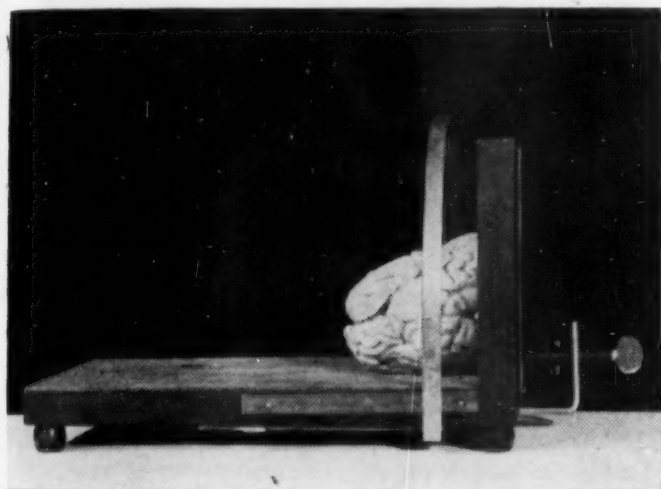


FIG. 1

For the study of the brain and other large organs, such as the liver, it is often desired to have macroscopic sections of uniform and known thickness. This is accomplished readily and easily with the macrotome to be described. The instrument consists of a base and an end board of hard wood with a metal arch, properly supported, which is used as a guide for the knife. The thickness of the section is determined by the distance between the arch and the end board as measured by a millimeter scale attached to the side of the base and adjusted by means of a thumb screw (Figs. 1 and 2). For the base, a piece of hard wood 12 x 9 x $\frac{3}{4}$ inches is used; for the end board one 9 x $6\frac{1}{8}$ x $\frac{3}{4}$ inches. Two countersunk screws are used to fasten the end board at right angles to the base. One piece of bar steel 30 $\frac{1}{2}$ x $\frac{3}{4}$ x $\frac{3}{16}$ inches is bent to form the arch, the ends being

welded and the joint buffed smooth. Two pieces of bar steel 6 $\frac{1}{2}$ x $\frac{3}{4}$ x $\frac{3}{16}$ inches are used for the side guides, which prevent side sway and twisting of the arch. One piece of bar steel 12 $\frac{1}{2}$ x $\frac{3}{4}$ x $\frac{3}{16}$ inches forms the center guide and pressure bar to regulate the thumb screw. This piece must be drilled and threaded to accommodate a $\frac{3}{8}$ inch thumb screw having at least 2 inches of thread. A small piece of light metal should be fastened to the back of the end board for the thumb screw to work against and to prevent it from cutting into the wood. Four keepers of metal are used in which the guides move. To complete the apparatus four rubber feet are attached for support. Details of construction are shown in Fig. 2.

The blade used to cut the sections is 18 x $\frac{1}{2}$ inches and is drawn taut in a hacksaw handle.

To cut the sections, the thumb screw is turned until the arch reaches the desired distance from the end board, as measured by the millimeter scale. The specimen is placed on the base so that it touches the end board in the desired plane. The knife is then placed against the arch and drawn through the specimen with one long stroke, taking care that it touches both sides of

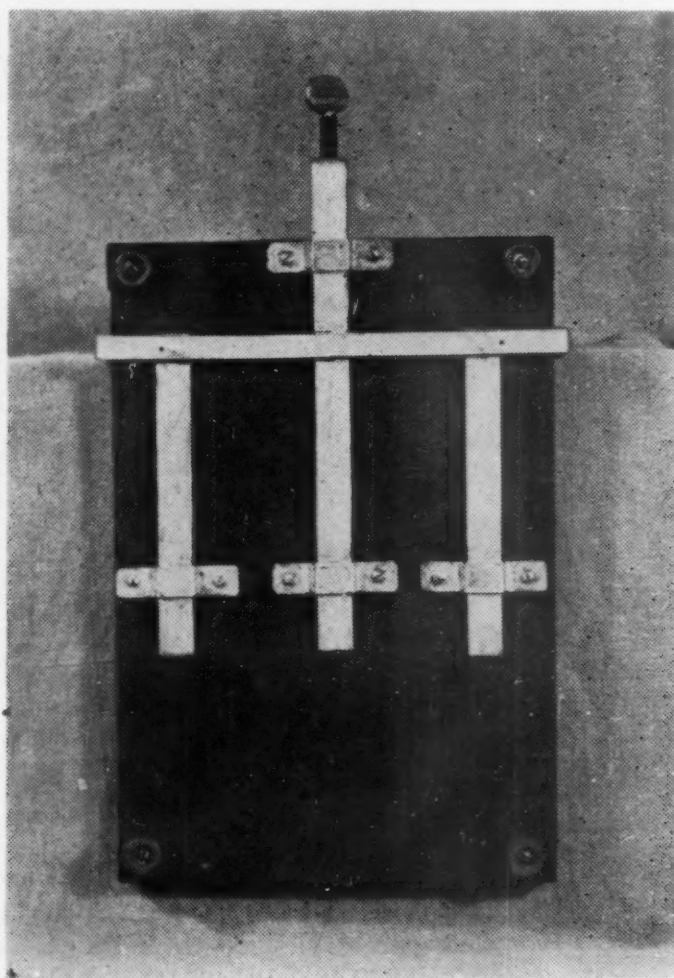


FIG. 2

the arch throughout the entire stroke. In holding the specimen on the base and against the end board only a moderate amount of pressure should be exerted, *i.e.* sufficient to keep the specimen from moving.

Formalin-fixed specimens have been sectioned at 3 mm. with little difficulty and at 5 mm. with no difficulty. Thicker cuts have also been made. Removal of the pia mater facilitated sectioning of the brain. It was found, however, that brains embedded in agar and chilled did not section evenly because of the resistance offered to the knife by too firm a block.

¹ We wish to express our appreciation to Otto F. Kampmeier, head of the Department of Anatomy, for affording us the facilities to do this work.

Book Reviews

High polymers. Vol. VII: *Phenoplasts: their structure, properties, and chemical technology*. T. S. Carswell. New York-London: Interscience, 1947. Pp. xii + 267. (Illustrated.) \$5.50.

The purpose of this book is to describe the chemistry and physical structure of phenoplasts (resins obtained by the condensation of aldehydes with phenols) and to show the relation between their structures and their mechanical and chemical properties.

The major part of the description of the chemical structure is contained in the first 50 pages of the book. Here the works of Zinke, Hultsch, and von Euler serve as the main basis for the development of the concept that now exists of the chemical structure of the phenoplasts. This section is followed by 18 pages of discussion devoted to an elucidation of the physical structure. The rest of the book furnishes quantitative data and other useful information on fillers for phenoplast molding powders and laminates; the effect of variables on the mechanical, electrical, and thermal properties; the chemical resistance and solubility of phenoplasts; and the manufacture, modern molding practices, and technical applications of these materials.

The literature of the last 10 years supplies the principal source material for this survey. The subject matter is presented in a very readable manner. Those who work with phenoplasts will no doubt be properly grateful to Mr. Carswell for an excellent reference book, and beginners will find the study of this book one of the best introductions to the field.

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An introduction to vertebrate anatomy. (Rev. ed.) Harold M. Messer. New York: Macmillan, 1947. Pp. xx + 475. (Illustrated.) \$4.75.

This book is designed for a one-semester course in vertebrate anatomy. It is the author's avowed purpose to present "a minimum amount of material," this material to be supplemented in any manner that the instructor wishes.

Approximately one-quarter of the book is devoted to (1) Introductory Remarks, (2) Taxonomy of the Chordates, in which is included the anatomy and general and specific characteristics of the protochordates, also general and specific characteristics of the vertebrates, and (3) a section on Early Vertebrate Development. The remainder of the text proper consists of a presentation and discussion of the systems of the vertebrate body, each presentation being concluded by a short summary. There is a short bibliography of suggested readings, an adequate glossary of biological and taxonomic terms, and a good index. The taxonomy has been revised. Textual material has been brought up to date and is accurate and singularly free from misprints. With few exceptions, the book is very well illustrated.

The reviewer, although having taught a one-semester course in vertebrate anatomy for a number of years, would prefer having a more comprehensive text than the one here reviewed.

Taxonomy and embryology are indispensable adjuncts to the teaching of vertebrate anatomy; however, it seems that the amount of space devoted to these subjects is more than ample when compared with the rest of the book. Certain sections of the text proper have suffered because of generalizations and omissions due to brevity. Summaries might well have been omitted. It might be helpful to the student to give the actual derivations of the taxonomic terms and the derivation of some of the biological terms. Although the bibliography is short and more or less on the elementary level, additional well-known reference books in English and German might have been included—to name only one, the 2nd edition of Romer's *Vertebrate paleontology* (1945).

In spite of the above personal preferences, the text can be satisfactorily used in the course, or in a course similar to the one for which it was designed. The book should serve to "whet the appetite" of any student genuinely interested in vertebrate anatomy.

ROY P. ASH

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The work book of fundamental organic chemistry. (Rev. ed.) Ed. F. Degering and collaborators. Ypsilanti, Mich.: Univ. Lithoprinters, 1947. Pp. 256. (Illustrated.) \$1.75.

This book, according to the preface, was produced in response to an urgent need to stimulate more active and less passive activity on the part of the student. It follows the plan of the author's *Outline of organic chemistry* and *Fundamental organic chemistry*. Each chapter contains (a) a review summary, (b) a genetic chart emphasizing the more important reactions, (c) nomenclature, pronunciation, and formula tables, (d) a composite review summary, (e) review questions of the fill-in type, and (f) one or more objective tests.

Every teacher of organic chemistry should examine this book, for it illustrates many excellent teaching and testing devices. The emphasis on nomenclature and pronunciation is especially commendable. This feature alone is of sufficient merit to recommend the book to anyone who wants to speak like a literate organic chemist.

Prof. Degering must find this book exceedingly valuable for use in his own classes. Teachers who use his text or outline and are in agreement with him as to course content and order of presentation will likewise find it of great usefulness. Other teachers who are masters of their field will find some parts of value but may prefer to design their own review questions and aid their students to develop their own devices for learning.

The chapter summaries are of less value than the other features of the book. In this reviewer's opinion students should prepare their own outlines and other summaries of textbook material. In spite of this criticism, however, the book is recommended as a valuable contribution to the art of teaching organic chemistry.

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